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...the journal of cinematic illusions

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In his latest cinematic extravaganza, *True Lies*, writer-director James Cameron spiced his trademark action with comedy in depicting a few days in the harried life of Harry Tasker—a secret agent whose super-secretiveness extends even to his wife and family. Assigned to deliver the lion's share of visual effects for the film was Digital Domain—a startup company formed by Cameron and associates—which produced more than a hundred traditional and digital effects shots. Providing major and minor support were a number of other companies including Pacific Data Images and Boss Film Studios. *Article by Don Shay.*

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COVER—An aerial battle over the streets of Miami in *True Lies*.
(Photograph by Zade Rosenthal.)

SPECIAL VENUES

MOON SHOTS

article by Jody Duncan

Since April, visitors at the Six Flags Great America park in Gurnee, Illinois, have been boarding 'Space Shuttle America,' a ridefilm attraction featuring a thrill-packed trip to the moon. Dream Quest Images was responsible for the three-and-a-half minute film which, combined with a motion platform designed and built by Intamin, makes for an exciting adventure in pseudospace.

The attraction begins with guests being escorted into a theater designed to replicate a small passenger bay inside the shuttle. Projected on a large screen is an image of the interior shuttle wall – a four-by-three-foot wall miniature that was a fairly accurate representation of the real shuttle interior. "The miniature was covered with a quilted insulation padding," noted production designer and model shop supervisor David Goldberg, "just like in the real shuttle. We duplicated that, using silk backed with foil and pressed down over soft foam rubber."

With the guests secured inside, the passenger bay is supposedly elevated to afford them a clear view out of the cockpit. A trembling of the motion platform, combined with an upward movement on the screen wall image, simulates the elevation of the passenger bay. The wall miniature itself was locked down, with only the camera providing the illusion of movement. "To get the lift up over the model," stated director Mike Shea, "we mounted the camera onto a mechanical device. Usually in motion control you try to make moves look as un-mechanical as possible; but in this case we made it look mechanical, with clunks and glitches as it raises up."

The wall model was shot against bluescreen by Shea and miniature photography supervisor Scott Beattie, then composited with a starfield to create the view outside the cockpit. "Every star you see in the piece was CGI," noted digital supervisor Tim Landry. "We had to get our motion control systems to talk to the computer graphics systems so that we could hook up our stage footage with CG footage without a lot of hand-tracking. Our motion control systems are able to output straight numbers; and Electric Image – the software package we were using – has the ability to input spreadsheet data. So all we had to do was format the raw numbers from our motion control systems into a spreadsheet that Electric Image could recognize."

While Electric Image was used for animation and rendering, Lightwave performed modeling tasks. "Our stars were two- and three-pixel dots of varying brightness," Landry remarked. "Lightwave generates particles, which are coordinates in 3-D space. Electric Image assigns dots of specific diameter to those coordinates. So we had clusters of dots which we copied and rotated on various axes in order to make them appear random."

Outside the cockpit, another space shuttle is revealed destroying space debris. The rented two-



foot-long model was placed on a modelmover and photographed bluescreen. “That was traditional model photography,” Shea commented, “where the camera did all of the Z-axis motion and the model gimbaled in one place.” Space debris was made up of bits and pieces found in the model shop. “We took popcorn, glitter – anything I could find on the shop floor – and shot it on stage high-speed. Then, with the debris on a flat card in the computer, we positioned that card, sized it to the shot and gimbaled it to give it the right perspective. We re-output that on a piece of film, generated a matte from it and composited that element into the shot.” Laser beams emanating from the shuttle were generated in Adobe using several software packages, including CoSA After Effects.

An orbiting LVRM stands ready to propel theme park travelers to the moon in the Space Shuttle America’ simulator attraction produced by Dream Quest Images for Six Flags Great America.

The passengers’ POV next reveals the earth as seen from space. The shot was achieved with a six-foot-diameter globe model. “It was made out of fiberglass,” Goldberg explained, “and had a tube that ran all the way through which allowed us to hold the globe up at either end. The globe had been previously painted by Ron Gress, who added finishing details in the areas we were featuring in our shot.”

Moving away from earth, the shuttle approaches a space station – a five-foot-long model that was hung on wires and shot bluescreen. Near the space station is the LVRM – Lunar Run Velocity Management Accelerator – a tunnel-like structure that ‘slingshots’ the shuttle toward the moon. The model was about thirty feet long and made out of chemically etched brass trusses that were soldered together. The tunnel itself was a tube twelve inches tall and eighteen inches wide. Equipped with a removable top, the LVRM was filmed on Dream Quest’s gantry stage with an overhead miniature Vistavision camera.



An intricate forty-foot-square miniature was constructed for an overflight of Armstrong City, a lunar settlement of the future.

Inside the LVRM, the passengers experience a computer generated warp drive effect. “Again, we had to match the CG universe to the model universe,” Landry noted. “Since the LVRM tunnel and the warp effect had the same vanishing point, they had to track precisely.” As the shuttle comes out of the warp drive, a long shot of the moon is revealed. A zoom from a computer generated moon down to a tabletop moonscape simulates a rapid, three-second descent. “The challenge was to hook up from the CG model to the landscape model and to match the zoom in such a short amount of screen time. We had to recreate the motion so that it was the same as what they had done on the stage.”

Sculpted out of foam by Mike Hosch, the lunar miniature was approximately forty feet square. “The landscape was built three feet off the floor,” said Goldberg, “and the front of it curved from that height down to the floor. The camera starts low, then moves up over this curve, which simulates a horizon.” As the camera changes direction, the landscape appears to move closer as if the shuttle is descending. “We built the landscape in three, increasingly scaled sections so that the surface would

appear to get closer as the camera moved from one section to another. We were going from a vista that looked as if it could be hundreds of miles below to a landscape that was much closer to us as we descended.”

As the shuttle skims over the lunar surface, the towers of Armstrong City, a futuristic moon settlement, suddenly appear. “The city had a central tower which was three-and-a-half-feet tall and domes ranging from nine to twelve inches in diameter,” noted Goldberg. “The miniature set had practical lights, spinning radar dishes and monorails moving through it.” During the fly-through of Armstrong City the shuttle enters a mining trench. “There is an unwritten law in theme park simulator rides – there has to be a trench shot. The reason is because it works so well. You get things whizzing by close to camera and it gives you a real sense of movement and excitement.”

“We fly over Armstrong City,” explained Shea, “then do a hook-up into a large-scale trench that was wide enough that we could bank left or right. We built two-dimensional cutouts for the background. For the foreground, we cut off the tops of the mountains that had been on the moon landscape, and I poked those mountains up above the edge of the trench from time to time. By doing that, we got some semblance of a landscape without having to build an entire tabletop.”

Receiving word from the command center of an approaching meteor shower, the shuttle captain determines to abort the moon landing and return immediately to earth. What follows is a thrill ride as the shuttle dodges asteroids on its way back to the LVRM. More than a minute long, the entire sequence was computer generated. “We modeled half a dozen asteroids in Lightwave,” explained Landry. “Those models came out very smooth, so we added texture to them with exaggerated bump maps.” Explosions shot on stage and tracked to computer graphics laser beams simulated the destruction of asteroids as the shuttle defends itself.

Surviving the asteroids, the space shuttle makes a rapid reentry into earth’s atmosphere. The crisis is not over, however, since the passenger bay is jammed in its elevated position and is thus in danger of burning up in the atmosphere. As flames begin to lap up the side of the shuttle, the bay finally unjams and the passengers are safely returned to earth. The convincing flames were created with liquid nitrogen lit with orange gels and shot time-lapse.

Of necessity, ‘Space Shuttle America’ is more reality-based than most simulator rides. “Everyone knows what the space shuttle looks like,” Shea concluded. “So this film had to be grounded in reality. But that has been our bread and butter at Dream Quest. Our most successful effects have been those where we were reproducing reality.”

QUICK CUTS

TERMINAL EFFECTS

article by Jody Duncan

The daring sport of skydiving is the backdrop for *Terminal Velocity*, a Hollywood Pictures release directed by *Deran Sarafian* and produced by Interscope. Showcasing stunning aerial sequences achieved through a combination of bold stuntwork and visual effects, *Terminal Velocity* centers on the unlikely pairing of an ex-KGB agent (Nastassja Kinski) and an expert skydiver (Charlie Sheen) who join forces against ill-intentioned agents who have stolen a fortune in gold.

Numerous jump sequences required the expertise of an aerial unit headed by Kevin Donnelly, physical effects rigged by Larry Cavanaugh, and digital effects produced by visual effects supervisor Christopher Woods. Woods, who had been with R/Greenberg Associates in New York for ten years, relocated to Los Angeles in 1991 to provide the visual effects for *Super Mario Bros.* While on that film, he worked closely with production designer *David L. Snyder*; and it was Snyder who suggested him for *Terminal Velocity*. Initially setting up shop at Interscope with a single workstation, Woods eventually acquired other high-end tools and assembled a team of digital artists. The resulting facility – put together solely for the production – was dubbed Terminal Effects.

One major effects sequence takes place near the end of the film when Sheen's character, Ditch Brody, attempts to evade villainous KGB agents by driving a Cadillac Allanté out the back of a cargo plane. With an armed agent on the hood and the heroine in the trunk, a fight ensues as the car free-falls from eight thousand feet. After finally overcoming the agent, Ditch just manages to rescue Kinski from the trunk and engage his parachute before the car explodes on impact below.

Donnelly's unit oversaw a number of aerial releases in which real Cadillacs – minus weighty transmissions and engines – were dropped from a plane in flight. "The director's idea from the beginning was to do as much as possible in the stunt work, with the help of wire removals in post," said Woods. "They made about ten drops using real cars with parachutes on them – either dropping them out of an airplane or hanging them from helicopters." Skydiving stunt doubles were positioned on the falling car for the live-action drops.

To achieve closeups of the actors inside, a car was mounted on a gimbal rig – designed and built by Larry Cavanaugh and his physical effects crew – and photographed bluescreen. "The gimbal rig had an arm that could lift the Cadillac about fifteen feet into the air," Woods explained. "It was hydraulically actuated and could move the car in all directions, providing realistic tumbling motions." A thirty-by-sixty-foot bluescreen was used to shoot the rig-mounted car outdoors. "We felt that outdoor bluescreen was the best way to go, since our shots would have to match the aerial units' footage of the



With an enemy agent on the hood and a woman locked in the trunk, ace skydiver Ditch Brody attempts a daring

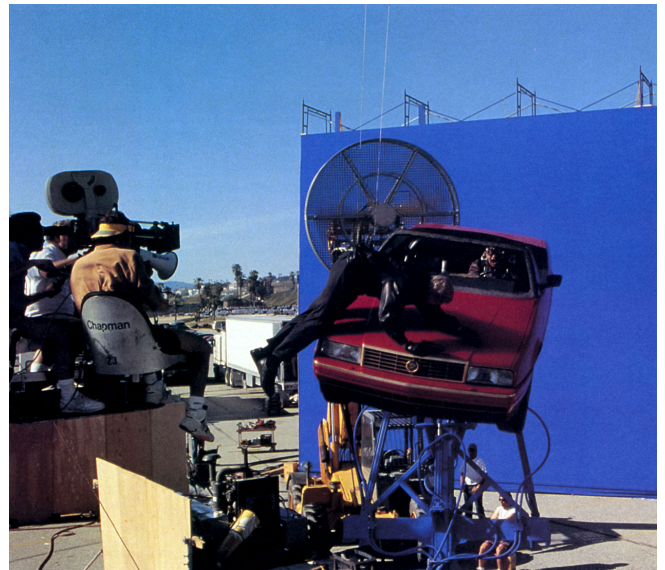
car being dropped out of the plane. A car is very reflective. At eight thousand feet, it would have light on it everywhere and that would be difficult to recreate on a stage. Also, I knew we would need a lot of wind in these shots, and I was worried about wind machines blowing lights around.”

escape and rescue by driving a Cadillac out the cargo door of an airplane in flight in Terminal Velocity.

One problem Woods encountered with the outdoor bluescreen was that it would ripple in the wind like a large sail. “It was only because of the sophistication of our matting software that we were able to pull a matte off that initial footage. Outdoor bluescreen matting is far from ideal under any circumstances; but eventually we had the procedure pretty well nailed and were able to get the screen to stay taut, without any ripples.”

In some cases, the effects unit was able to get away with poor man’s work, shooting the gimbaled car against the sky rather than the bluescreen. “That worked out for really tight shots. We would shoot from a Titan crane which moved around enough to keep you disoriented and unsure of what you were looking at. For those shots we would fly the actors on wires.” To create the impression of wind blowing on the actors, Woods used powerful hydraulic fans. “We started out with Ritter fans, and then we tried air movers – but neither was powerful enough to simulate that kind of fall. Finally we got two hydraulic fans, and they were great. They were significantly more powerful than the Ritters; and they had a nice mount which enabled us to put them on a big forklift, get them way up in the air and angle them however we wanted. We could also point them straight up and hang someone directly above them.”

Aerial backgrounds for the bluescreen shots were filmed primarily at Lone Pine in the California high desert and at an abandoned army facility in Arizona. “We shot background plates throughout the production. A lot of the stuff was taken from a helicopter as gyro-stabilized plates. That proved interesting because the gyro-stabilized mounts are purposefully built to be very steady and smooth, and yet we needed some spinning, flipping backgrounds since the car was tumbling as it fell.” Other backgrounds were achieved with helmet-cams. “Skydivers would put cameras on their helmets and shoot as they fell.”



Live-action stunt work was augmented with digitally composited outdoor bluescreen footage of actors on a gimbal-mounted car.

The helmet-cam approach was also used to photograph characters making jumps; however, the experienced helmet-cam skydivers needed to adjust to the dramatic requirements of the film. “In skydiving competition, a helmet-cam person will go out with a skydiver and film him as he jumps and falls so that judges can properly evaluate the performance. The way they shoot this stuff for competition is to keep the skydiver perfectly framed at all times. But for an action sequence, that same approach to filming a jump just doesn’t work. There is no sense of hurtling towards the ground at 120 miles per hour because the helmet-cam

person is falling at the same *Speed* as the jumper. So Deran had to figure out how to make those shots as exciting and dangerous as they actually were. He came up with guidelines for filming this stuff that we carried through in the effects work.”

Digital composites of the car and background elements were completed in postproduction. “The challenge was that we were working in this outdoor situation, which meant the bluescreens were pretty funky in some cases. There were some color corrections we had to do. Mainly there were just edges that didn’t want to pull very well. We would pull a variety of mattes – sometimes ten or fifteen different matte passes – and then put them all together to make one matte.”

Some computer animation was also implemented in postproduction to enhance the falling car shots. “The car was supposed to be falling at 120 miles per hour, and yet it was actually on a gimbal rig which didn’t travel at all. So for the wider shots, I would shoot the car full-frame and get the relative perspective changes on it; then we would animate it to look as if it was starting very small and coming at us, or starting large and moving away from us – all while doing these tumbling and rotation moves. Computer animation was a big factor in some of those shots.”

By the end of postproduction, Woods and his associates had completed some 120 effects shots for *Terminal Velocity*. “Both *Super Mario Bros* and *Terminal Velocity* have been very interesting and satisfying projects for me,” Woods noted, “because both gave me the chance to put together a facility for the run of a show, and to tailor that facility to the kinds of effects that show would require. That kind of setup gives the production a lot of flexibility; and it gives me a lot of freedom in putting the work together and designing new effects.”

VIDEO BEAT

ALIEN NATION REVISITED

article by Bob Peishel

Alien Nation, a 1988 20th Century Fox release, explored the impact of nonterrestrial beings being integrated into human society. In 1989, a television series based on the movie likewise examined the human condition through the eyes of Detective Matthew Sikes (Gary Graham) and his alien partner George Francisco (Eric Pierpoint). Despite an avid following, the series was canceled in 1990, leaving some critical plot questions unanswered.

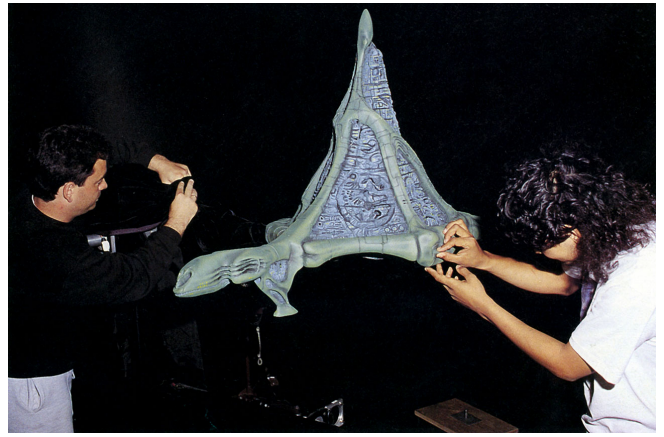
Now, four years later, Fox Television has produced *Alien Nation: Dark Horizon* to resolve the final episode's cliffhanger. Executive produced and directed by Kenneth Johnson, creator of the series, the two-hour television movie reunites many of the original cast members and creative team in a story in which alien Aposso (Scott Patterson) attempts to capture the thousands of aliens living on earth and return them to bondage aboard the *Nebula Cruiser* slave ship.

Overseeing the entire effects assignment for the show was visual effects supervisor Bill Millar. Fox Television also brought in Digital Magic – a digital effects and postproduction studio in Santa Monica – to composite and produce some of the film's twenty effects sequences.

As conceived by Kenneth Johnson and production designer Brent Swift, the effects for *Alien Nation* were to have a decidedly organic look. That organic style is most evident in the spaceships featured prominently in the opening moments of the film. The opening sequence reveals a huge mothership in space, attended by smaller vessels moving around it. Both the mothership, the *Nebula Cruiser*, and the smaller fleet tenders consisted of steel tubing covered with polyurethane foam that was hand-carved and painted to create a basic structural look of bone with an external shell of organic material.

Although the *Nebula Cruiser* was supposed to be a massive ship housing thousands of smaller spacecraft, budget limitations required the effects crew to explore creative methods for conveying the vessel's immensity with a model that was merely five feet long. One simple solution was to film the ship only in long, slow cuts. The illusion of size was also enhanced by minimizing the amount of light emanating from its windows. Rather than adorn the ship with real light sources that would have given off too much illumination – and thus thrown off the scale – tiny windows were painted on the model in fluorescent paint and photographed with black light. The same technique was used on the inverted pyramid-shaped fleet tenders. Only three feet long, the fleet tender models represented ships that supposedly measured three football fields in length and housed several hundred people.

Constructed by Millar's crew, the models were filmed motion control on stage by Digital Magic's Paul Saivetz, Stephen LeBed, Scott Price and Jeff Zaman. "The producers wanted a very harsh, one-light type of look reminiscent of 2010," Saivetz said. To achieve the look, a single key light was used for the beauty pass on the model. A fill pass was then filmed as a separate element. "This gave the digital effects compositors greater control, allowing them to selectively put in as much or as little fill as desired. In addition, should the fill light be of a specific color – such as the light reflecting off a planet – its color could be adjusted accordingly." Matte passes were filmed using day-glo orange screens lit by Videssence fluorescent black light fixtures.



For the TV movie Alien Nation: Dark Horizon, crew members Steve LeBed and Scott Price of Digital Magic ready the alien fleet tender for a multi-pass motion control shot.

A six-foot-wide hemisphere of white plexiglass was employed to create the starfield surrounding the spaceships. The inside of the hemisphere was painted black and then thousands of tiny pinholes were scratched into the painted surface. During filming, the hemisphere was backlit and photographed by a motion control camera placed within the dome.

The various planets and moons featured in the opening shots were created with different surface textures in the System G, an electronic device which allows the visual effects editor to take various video elements and wrap them into whatever shape is desired. After processing, all of the film elements were transferred to D-1 tape by Lynette Duensing and Michael Mazur in one of the Digital Magic telecine bays. These elements were then loaded onto different digital disk recorders in compositing suites where digital effects compositors Don Greenberg, Scott Rader and Paul Hill would take two, three or four elements at a time and combine them to assemble the shots. The final composite for the opening sequence consisted of between forty and sixty different elements.



Digital Magic also combined artwork and live-action elements into three digital matte paintings representing the enormous interior of the alien mothership.

Later in the film, another organically-inspired spaceship makes an appearance as a hologram which hovers over a conference table inside the Nebula Cruiser. The flying saucer, which had the same bony structure as the other ships, was a computer generated element created by John Musumeci on a Silicon Graphics Indy workstation using Softimage software. Musumeci scanned in a circuit board from a Betacam recorder in order to create a texture map for the surface of the saucer, while a computer model of a human toe provided the basis for its bony ribs.

Digital Magic also created three digital matte paintings which represented interior locations within the mothership. The production team provided rough production paintings which were put into the Harry where Cam de Leon and Simon Holden repainted them in proper scale and perspective. "The interior of the mothership is a huge, cavernous space," said facility creative director Rich Thorne, "and in many ways repetitive. Once our artists achieved the look of a particular zone, they could digitally move pieces around and retouch them to add more or less detail." One of the paintings depicts an area where thousands of single-man ships are stored. "To paint the detail of each one would have taken a matte painter forever. But we could take one, duplicate it, and then retouch it to make it fit in any position."

Two of the three matte paintings showed towerlike landing pods used by the fleet tenders. Rather than paint all of the pods, the visual effects team determined that it would be more effective to film a pod model from a variety of angles and then position the resulting footage into the painting. A model of the landing pod was built; and the motion control crew, using one of the original production design matte paintings as a reference, filmed the model in all of the correct positions and perspectives for inclusion in the matte painting. Also incorporated were live-action elements of aliens descending and ascending the towers in elevators. Actors were filmed by the first unit in front of a bluescreen, and the resulting elements were composited into the painting. Animated light gags and smoke elements were also added to enhance scale and ambiance.

Digital Magic's most personal contribution to the film was for a hospital scene in which a check of vital signs on George Francisco's alien wife Susan (Michele Scarabelli) and daughter Emily (Lauren Woodland) reveals that the characters have two hearts. Instead of using digital or other means to create the illusion, Thorne visited a family physician, and with a video camera filmed the image of his own heart off the sonogram monitor. The footage was then brought into the compositing bay where one heart became two for the playback.

Although *Alien Nation* featured only a small number of effects scenes, the project presented interesting challenges for the artisans at Digital Magic. "All of the work was intricate and detailed," Rich Thorne said, "and that was the fun and attraction of this particular movie. This show had a few really strong and beautiful effects as opposed to the one or two hundred that you might normally do. Like *Star Trek*, *Alien Nation* is a show about people, not visual effects."

COMPANY FILE

ANIMAL MAKERS

article by Brian Keeney

W.C. Fields admonished entertainers never to work with children or animals. Although there could have been no National Velvet without horses, no Lassie Come Home or Beethoven without dogs, and no Bringing Up Baby without a leopard, many a filmmaker has reflected on Fields' folksy advice when trying to complete a difficult shoot involving animals. Even the most well-trained of animal actors may suffer from a lack of 'directability' when a contrary mood strikes. And there are other factors. While few actors would be hesitant to work with a dog or a horse, not many would be eager to antagonize a nine-hundred-pound bear to fulfill some screenwriter's fantasy. Traditionally, the film producer's choice has been either to keep animal sequences to a minimum of shots or use an animal puppet – a risky proposition if the puppet is not a convincing replica of its live counterpart. With such limited options, 'animal' movies have presented more than their share of headaches to filmmakers. Animal Makers, however, is helping to lift the animal taboo.

Located in three units of an industrial complex in Newbury Park, California, Animal Makers has been quietly meeting the call of film producers and advertising agencies from Los Angeles to New York for more than a decade. Specializing in animatronic recreations of all animal species – ranging from a wild boar in *Predator* to an animated beaver in National Lampoon's *Loaded Weapon* – Animal Makers, according to president Jim Boulden, is filling a unique niche in an industry leaning more and more toward specialization.

In 1980, Debi Boulden, Jim's wife, was deeply entrenched as an advertising executive at the Southern California Hospital Council. Years of paperwork and desk-bound duties had left her unfulfilled and longing for a new career path. Having created animal replicas as a hobby since childhood, Debi looked into marketing a few of her favorites, just for fun. "She made some cats and bears," recalled Boulden, "and then took them to a big gift show." Her creations were a surprise success, stimulating orders by the dozens. "The orders were more than Debi could fill in her spare time; so she left her job and started making these things full-time on the floor of our apartment."

After several years of selling through retail outlets, Animal Makers received its first call from Hollywood in 1985. "The American Humane Society had heard about us and called us in on the Disney Sunday Movie series," Boulden explained. "Knowing nothing about the film industry, we went down and met with Disney; and they put us on five shows right away. That introduced us to a whole new market we had never considered before. I ran with it and started promoting our animals through Paramount, Universal and the like."



Among the hundreds of artificial creatures produced for movies and TV by Animal Makers was a playful

'Choiceasaurus' that enlivened a series of commercials for Choice Hotels.

Thrust into the world of motion pictures, Animal Makers was forced to explore ways in which their heretofore stationary creations could be

mechanically articulated to simulate lifelike action. "Our animals always looked good; but now we had to come up with movement. We started off very simply – with basic levers, little triggers that articulated mouths and paws, very rudimentary stuff – but we worked hard to progress at the mechanics; and within the last three years or so, we've really buttoned it down."

As the company's mechanics improved, its client list expanded. Animal Makers began a profitable collaboration with the commercial industry, doing television spots for General Motors, Friskies Cat Food, Sony and the Miller Brewing Company. With the company growing year by year, Boulden added a new facet to standard creature shop offerings – animals for rent. "It was a response to the economics of the time. We don't get as much for jobs today as we did two or three years ago; so we've addressed the problem by charging the client less for the initial product, then taking the puppet back and placing it in our rental inventory. It's become a more efficient option for many of our customers. They get what they need at a low cost, while we make our profit over the next five years."

Expanding from the commercial market, Animal Makers completed its first big Hollywood feature in 1990, with the Disney adaptation of Jack London's *White Fang*. Hired to create wolves – both nonarticulated puppets for death scenes and fully articulated ones for attack sequences – Animal Makers worked closely with the film's animal trainer and director to execute attacking wolf shots that were dynamic, yet safe for cast and crew. "For *White Fang*, we made a hero wolf body with interchangeable heads," Boulden related. "One of the heads was employed in a fight scene with a live dog, thus allowing the director to compose a closeup wolf fight without having two unpredictable animals fighting violently near cast and crew. The head was a hand puppet with cable and radio controls. Its mouth opened and snarled; its ears drew back; its eyes opened and closed. With it, the director was able to stage the fight with complete control."

In May 1991, Animal Makers achieved its greatest success to date with a small animatronic dinosaur created for a series of television commercials promoting Choice Hotels. In the spots, the dinosaur – a cuddly triceratops with a posterior in the shape of a suitcase – plays with kids, lounges on hotel beds and even rides the subway while promoting a summer sweepstakes, free rates for children and 'Choiceasaurus' toys. "The spots were a major undertaking for the client and their franchisees. We created two different characters, fully animatronic, with four-way eyes, mouth movement, nose twitching and tail articulation. It was quite a big gamble for them." The gamble paid off, as the commercial series secured the chain its most successful summer earnings ever.

Animal Makers' recent work included a ten-foot-tall Kodiak bear for a dream sequence in *On Deadly Ground* that had actor-director Steven Seagal wrestling with the beast. The bear was realized as a full-size animal suit worn by veteran suit performer Brian Simpson, with cable-actuated arm extensions and servos to control facial and neck movements.



Achieving realistic facial movements was a principal objective for the creature crew. "In an animal face, there are hundreds of muscles that create movements," Boulden stated, "but we have to reduce them down to a handful of pulls and pushes. We like to assign as many moves to as few puppeteers as possible. By using three-axis controllers, for example, one person can handle six movements. That helps us to achieve a singular, flowing performance rather than a series of unnatural actions and reactions. We're also continually looking for new products that will respond realistically to the subtle actions of our puppeteer's performance. The new silicone skins and skinflexes have been helpful in giving us an edge on realistic movement."

A Kodiak bear from Animal Makers battled Steven Seagal in On Deadly Ground. / An animatronic koala appeared in Ford Fairlane commercials.

The success of animal effects shots often depends on the lifelike detail incorporated into the animatronic puppets. Animal Makers' figure-finishing department – responsible for painting, furring and feathering the animals – has come up with a number of innovations to improve the detailing process. "We designed our own electrostatic fur application system," said Boulden. "It employs a flexible tube that we bend around the puppet, allowing us to get the 'plus and minus' charged ends close together. The fur comes through the charged area between the heads, is electrically attracted to the skin of the character, and adheres to flexible adhesive previously applied to the skin." The system enables the artists to apply the hair in any thickness or style, mimicking the nuances of each animal coat.

The rise of computer generated imagery as a viable means of producing creatures has worried some in the effects community, but Animal Makers welcomes the advanced technology. "As we see it, morphs and distortions and the like can be used to make our puppets look even more believable. Digital technology is becoming another color in the production palette. We'll embrace it if it helps our creations look better."

Hoping to continue their advances in animatronic animals, as well as expand their approach to managing the company, the Bouldens expect to take Animal Makers public within the next three years. "Using the strength of our work, we will continue to push into other markets. Film and TV are great, but they keep our animals trapped on a screen. We're looking for new situations such as marketing and trade show displays."

MAYHEM OVER MIAMI

image

article by
Don Shay

Harry Tasker is different things to different people. To most who know him, he's an average middle-class computer salesman with an average middle-class family who lives in an average middle-class home in suburban Washington D.C. To his wife, Helen, Harry's a nice enough guy, but maybe just a bit too average and middle-class. Helen longs for a little excitement in her life and, let's face it, Harry's about as exciting as a floppy disk. To his teenage daughter, Dana, Harry is inattentive and out-of-touch and, in the vernacular of his day, not hers, hopelessly square. But to the people who work with him, Harry is something different altogether, a human dynamo whose average middle-class veneer conceals – even from his family – a life of danger and excitement in the defense of his country. For Harry is the star field operative of Omega Sector, a top-secret spy agency with a no-holds-barred antiterrorist mandate.

Such is the premise of *True Lies*, the new comedy-adventure from writer-director James Cameron, the reigning monarch of large-scale action pictures. Unlike other Cameron projects – with original stories and screenplays by the director – *True Lies* was derived from a 1991 French comedy, *La Totale!* about a low-level bureaucrat whose clandestine life as a covert agent is kept ultra-secret even from his librarian wife. The impetus for an American remake came from Arnold Schwarzenegger, who suggested the project to Cameron as a possible collaboration. “Arnold was high on doing a comedy – this was before *Last Action Hero* came out, so he wasn't gunshy about action-comedy yet – and I liked the idea of giving it a try. I had done big action pictures and big



Action director James Cameron adds comedy to his palette with *True Lies* – a Lightstorm Entertainment production for Twentieth Century Fox – in which the archetypal secret agent genre is revitalized with a decidedly nineties twist. Threatening U.S. cities with nuclear annihilation, terrorist mastermind Salim Abu Aziz (Art Malik) confronts top Omega Sector operative Harry Tasker (Arnold Schwarzenegger), whose wife Helen (Jamie Lee Curtis) reacts in enraged disbelief upon learning that her husband of fifteen years has kept his work identity secret, even from her.



Visual effects supervisor John Bruno plots out a scene with Cameron for the film's finale in which Harry engages the terrorists in aerial combat over Miami.

visual effects pictures – so from a cinematic standpoint, there weren't a lot of technical challenges left to explore. But comedy was a challenge of a different sort – something new for me. Which is not to say that my other films are humorless. I think some of the scenes in *Aliens* with Hudson and in *The Abyss* with Hippiie are pretty funny. But the focus was different. In those, what I did was create a real situation and then riff on it a little bit – but not enough to puncture the reality of the film. In *True Lies*, it's more of a bait-and-switch where you create a realistic situation – although slightly fantastic – and then riff on it mercilessly.”

Adapting the modest French film to fit the larger-than-life filmmaking styles of both Cameron and Schwarzenegger entailed concocting an expanded storyline with a scarier threat – terrorists plotting to detonate nuclear bombs in U.S. population centers – and weaving through it several high-intensity action set pieces. Enlisting writer Randall Frakes – a longtime friend – to help brainstorm the major story points, Cameron subsequently drafted a detailed treatment and then the script.

Visual effects supervisor John Bruno was finishing *Cliffhanger* at Boss Film Studios when he received a call from Cameron that would set the course for the next sixteen months of his life. An Oscar winner for his work on *The Abyss*, Bruno was an accomplished artist who excelled in devising visual approaches to complex action and effects sequences. “Jim was writing *True Lies* at the time and wanted to know if I could help him come up with some cool stuff for the ending, which involved a Harrier – the vertical takeoff and landing jet the Marines fly – that the hero uses to destroy a nest of terrorists that have taken over a high-rise office building. The Harrier rises up from below and blasts out one entire floor – killing most of the terrorists inside. In the meantime, the hero's daughter has been chased onto the roof by the head terrorist and is climbing out on a construction crane when the hero appears in the jet and shoots the bad guy with a pistol. The terrorist falls to his death, the girl drops safely into her father's arms and the Harrier lands in the street below. That briefly was the ending. Jim asked me what I thought, and I said, ‘Well, I like it; but we should do more with the villain.’”

For the next several weeks, Cameron and Bruno faxed script pages and sketches back and forth and had frequent late-night phone conversations as they brainstormed ways to embellish the finale. Idea followed idea, and before long, sheer enthusiasm pushed the sequence way over the top. “We decided to have the hero hover beneath the crane and have his daughter drop onto the nose of the jet. Then, as they start to pull away, the villain jumps onto the wing and works his way up to the cockpit where he and the hero have a knife fight. The plane spins out of control and starts knocking into buildings, but the two keep slugging it out, striking the dash and launching missiles and generally wreaking havoc all over Miami. Finally, Jim remarked: ‘Wait a minute. This plane's being flown by the good guy. He's doing more damage than the bad guys.’ So we toned things down a bit. We spent a lot of time figuring out what to do with the villain. I suggested to Jim that it would be neat to somehow get him hooked onto a missile and then have the hero launch him. From there it went to launching him into a helicopter carrying other terrorists. Jim's final amendment was to launch him through the blown-out floor of the office building. So the hero makes this trick hip-shot – quick-draw style – and fires the bad guy right through the building and into the helicopter on the other side.”

Even as the screenplay was being formulated, key members of the production team were being assembled – many of them veterans of previous Cameron campaigns. Stephanie Austin signed on

as producer, reprising her role on *Terminator 2*. Peter Lamont – an Oscar nominee for *Aliens* – was back as production designer. T2 graduates Thomas L. Fisher and Joel Kramer would return to oversee the nonstop physical effects and stunt work. Ace film editors Mark Goldblatt, Conrad Buff and Richard A. Harris all had previous Cameron credits, as did composer Brad Fiedel and others up and down the ranks. New to the team was cinematographer Russell Carpenter, hot off the John Woo action thriller, *Hard Target*.

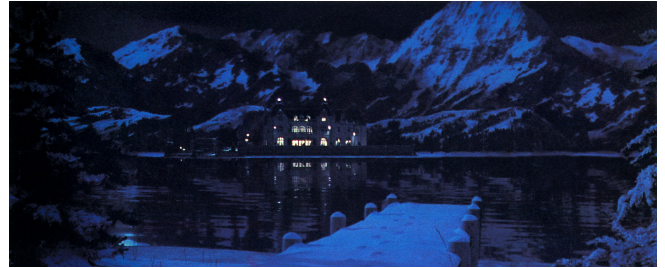
Visual effects would go to Digital Domain – no surprise, even though the company had barely hung out its shingle, since James Cameron was among its creative principals. In partnership with Stan Winston and Scott Ross – and with corporate underwriting by International Business Machines – Cameron had chartered Digital Domain with the goal of making it a first-rate effects facility with an emphasis on user-friendliness. “We were creating a facility from scratch and trying to do a picture at the same time,” stated Cameron, “which is always a tricky proposition. Sometimes it works – as with *Star Wars* and ILM – and sometimes it doesn’t. We knew we’d have to find space and acquire equipment. We’d have to assemble people. We’d have to create a methodology. We’d have to test everything. And by the time all that was done and we were ready to start making shots, nine-tenths of our time would be used up and we’d have one-tenth left to do all the work. But without the impetus of having a production with deadlines to meet, it might have taken much longer to get Digital Domain going. I think *True Lies* was exactly the jump-start that was needed.” While Scott Ross worked with production executive Brooke Breton and digital postproduction executive Steve Gray to get the facility up and running, freelance effects producers Julia Gibson and Mike Chambers were hired specifically to oversee *True Lies*. While their duties overlapped to a degree, Gibson focused primarily on the digital side of the production while Chambers focused on the stage and location photography. Coordinating effects activities at the production level was Pamela Easley.

When his *Cliffhanger* assignment ended, John Bruno segued directly into *True Lies*. Working initially out of production offices in the new Lightstorm Entertainment building in Santa Monica, Bruno enlisted artists Brent Boates and Tom Cranham and began turning out preliminary storyboards for the end sequence plus several others that would require elaborate visual effects. Principal among those was the sequence leading up to the finale over Miami. Arab terrorists of the Crimson Jihad have smuggled four nuclear weapons into the country and are transporting two of them via truck along the Overseas Highway that connects the Florida Keys to the mainland. To deal with the threat, Harry Tasker calls in the *Marines* who dispatch a pair of Harriers to interdict the shipment.

Before production even began, *True Lies* was being heralded as James Cameron’s take on the *James Bond* oeuvre. “The connection is inevitable,” Cameron allowed. “*James Bond* is such a clear cultural icon. Obviously, *True Lies* has some riffs on Bond that are pretty clear – and I tried to have fun with those. Like the lady-killer aspect. To me, *True Lies* is a fantasy and a fable about the schizophrenia of being married. Being a lady-killer and being married just don’t mix. Harry wants to be *James Bond*, but he has a wife and kid at home.” Eventually cast as that wife and kid would be Jamie Lee Curtis and Eliza Dushku. Art Malik would appear in counterpoint as terrorist mastermind Salim Abu Aziz. And providing the broad comedic strokes would be Tom Arnold and Bill Paxton.

Though the Marine Corps had agreed to lend support, even to scheduling a few Harrier training missions that would coincide with the photographic needs of the production, it was evident that much of the action in the finale would require special effects on a grand scale. “My initial thinking

was that most of it would be done with miniatures,” said Bruno, “but we all knew that, in some way or another, we had to establish convincingly that Arnold Schwarzenegger was flying a Harrier jet. In one complete take, Jim wanted to start in close on Arnold climbing into the cockpit, then pull back and show the plane lifting off and flying away. The only way I could think of to do that was to build a full-scale mockup of a Harrier and somehow marionette it from above for one or two shots.”



The film opens with Harry crashing a posh party being hosted by an international arms trafficker at his chateau in Switzerland. Live-action for the sequence was shot at a historic mansion in Rhode Island. To place the structure in its intended locale, Pacific Data Images created four digital matte paintings.



A miniature foreground for the opening shot was built on stage at Digital Domain. Miniature supervisor Pat McClung adds finishing touches by sprinkling a mixture of baking soda and salt to represent snow.

Engaged to construct the mockup was Donald Pennington. Pennington had built the full-size submersible mockups for *The Abyss* and had provided some custom props for *Terminator 2*, but at heart he was an aircraft enthusiast. Approached in early June, he was invited to participate in a production visit to the Marine Corps Air Station at Yuma, Arizona, where key department heads were given an opportunity to study the Harrier up close and observe it in flight. Shortly thereafter, Pennington was given the go-ahead to commence work. He had thirteen weeks to complete the job.

The initial step was to take fiberglass molds off an actual AV-8B Harrier. "Within a week of the time I signed onto the project, I was back in Yuma with a crew of sixteen. The Marines were great. They just went out and towed an airplane right off the flight line and put it in a hangar for us – and we started right to work." High on Pennington's list of priorities was making sure that no damage was done to the \$23.7 million warplane. "I had to be extra sure our fiberglass didn't bond to the surface of the plane. We began by smearing a thin layer of polyester wax onto the aircraft to keep the solvents in our resins from eating through. In most cases, the wax alone would be enough; but just to be certain, we applied polyvinyl alcohol on top of that to insure a clean release."

Twenty-four major molds were required, plus lesser ones for thrusters and pylons and smaller accessories. "The first step was to apply a gel coat – which we did by hand since I didn't want the mess of using a chopper gun. Then we took mat – which is a chopped strand fiberglass – wet it out with resin and laid it on the plane, using rollers to force out all the air. Depending on the thickness we needed, multiple layers were applied. After the fiberglass cured, we would reinforce the molds with wood or water pipe or electrical conduit – anything that worked." Following two weeks of intensive labor, Pennington and crew packed up their completed molds, cleaned up the plane and departed for Los Angeles.

As the potential of a full-size mockup filtered through the production, other uses for it presented themselves. "In going through the storyboards," Bruno recalled, "I realized that we had something like eighty-five effects shots, just for the end sequence alone. That was a budget-buster, so I started thinking about ways to cut the number of shots. It seemed to me that for the shots of Aziz hanging from the missile, we could take the full-size wing up onto a tall building in Miami and angle it to get the down-shots we needed without seeing the edge of the roof. And perhaps in a parking lot nearby we could get our reverse angles of Harry in the cockpit. That led to the idea of putting the entire airplane on a roof if we could find the right building. Jim thought that was a pretty interesting idea because it would allow us to do a lot in-camera."

A location scout of the Miami area turned up the Interterra Building, a largely vacant twenty-story structure in the downtown financial district. Not only was it architecturally pleasing – angular and



The dockside landscape was photographed against a greenscreen and delivered to PDI for incorporation into their shot – which included a live plate of the mansion and a computer generated lake surface.

mirror-surfaced – but protruding from its rooftop was a steel-reinforced housing for the elevator mechanisms that seemed an ideal platform for dramatic down-angles in almost any direction. To confirm this supposition, a seventy-second-scale replica of the building was fashioned by the art department, complete with miniature construction crane and Harrier jet. “While we were on the scout in Miami,” said Bruno, “I had taken a panorama of the city from the top of the building. We used those shots to make large blowups and built a cyclorama of sorts around the miniature. Then, with a Toshiba minicam, we started looking at angles based on the storyboards – and they were actually working out. From the side, we could shoot the plane above its pole mount and get the nearby skyscrapers behind it. And for certain down-angles, we could still lose the mount and see to the street without getting the edge of the building. We knew we would still need process shots and some miniatures; but by going this route with the live-action, we’d be able to cut up to fifty composites. So the decision was made, and we began revising and tightening up our storyboards to fit that approach.”

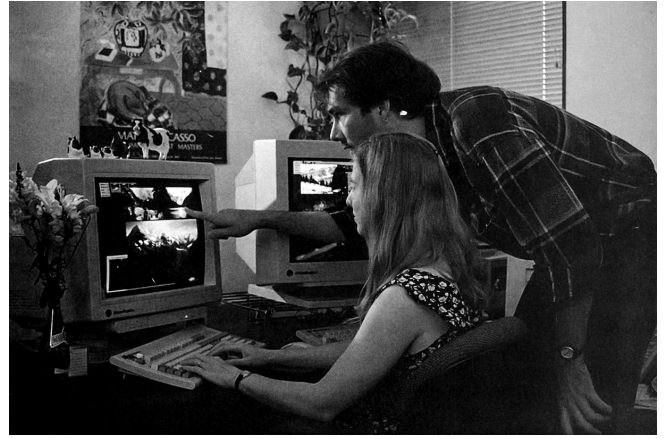
Acting on the recommendation of an old friend, physical effects supervisor Michael Lantieri, Bruno contacted effects engineer Mark T. Noel about developing the mechanical systems necessary to articulate the full-size plane in its expanding range of applications. Although a simple ball-joint or gimbal mechanism was considered adequate for the rooftop flight simulations, Noel – a member of the Lantieri team on *Jurassic Park* – proposed something more advanced for the involved stage work that would follow.

“I told them that a motion base was the only way to go,” Noel stated, “something like the one that was used for the T-rex in *Jurassic Park*.” Employing precision electronics and heavy-duty hydraulics interfaced by computer, motion bases have been used for decades to impart multi-axial motion to aviation flight simulators and, more recently, to theme park ridefilm platforms. The use of one to actuate a three-ton dinosaur had been something of an innovation for *Jurassic Park*, but an enthusiastic endorsement from Stan Winston – who had built the animatronic carnivore – was enough to convince the *True Lies* team to go with Noel’s recommendation. “Jim Cameron wanted as much motion as he could possibly get, so we went to McFadden Systems – the company that supplied the motion base for *Jurassic Park* – and ordered an even bigger one.”

The idea of a motion base fit in handily with Bruno’s perception of how the process work could be accomplished on stage. “Based on the shots we wanted and the amount of movement within them, I knew we were going to need the biggest bluescreen or greenscreen ever made, in conjunction with some wild crane moves or boom moves. It was going to be a complicated mix, so ideally the way to go would be to program the plane moves and the camera moves with motion control and then lock them together. In that respect, the motion base was a huge improvement over a ball-joint or gimbal mechanism because it could be programmed for near perfect repeatability.”

The question of bluescreen versus greenscreen resolved itself with the pronouncement by Jim Cameron that all composites in the picture would be accomplished digitally. "Digital Domain was gearing up at the time," recalled Bruno, "and the digital people already on staff said they would prefer greenscreen to blue – but no one had ever done a large project entirely greenscreen. We shot some tests with an F-5 from the Santa Monica Air Museum – using both bluescreen and greenscreen – and the green did produce better flesh tones and really popped out the jet, which was blue like the Harrier. So we went ahead and committed ourselves to the largest greenscreen ever made. But where would we put it? We couldn't find enough stage space anywhere in town." After months of scouring the region for possible sites, the production opted for the Syncro Aerodrome Business Center, a near-vacant hangar at the Van Nuys Airport that had seen prior film service on *Toys* and one of the *Nightmare on Elm Street* movies.

With weight estimates for the plane and motion base in the seven-ton range, one of the ways proposed by Noel to move the ungainly assembly around stage was to outfit the support base with pneumatic bearings that could lift the entire rig on a thin cushion of air. Cameron took the notion one step further. "We were at a meeting," Bruno recalled, "and Jim said, 'What if we build a platform on the roof and put it on air disks so we can slide the jet back and forth and get some movement?' I piped in and said, 'Well, why don't we just put the motion base on the roof?' It was kind of an offhanded remark, really, but Jim's eyes lit up and I suddenly realized that we were talking about putting Arnold Schwarzenegger, the number one boxoffice attraction in the world, 250 feet in the air on a gyrating machine with enough horsepower to push the entire building over. But Jim is not afraid of technology and machines. His feeling is that you get the best people to operate the machines and there won't be a problem." So, immediately, the focus narrowed and investigation commenced into the engineering and safety considerations attendant to erecting and operating an enormously powerful motion base, coupled with a full-size airplane, on top of a high-rise office building in downtown Miami.



Mountain backgrounds for the chateau shots were assembled from a selection of still photographs – treated day for night – that were stitched together digitally and seamed with painting elements. PDI visual effects supervisor Jamie Dixon and technical supervisor Barbara Meier study digitized travel photos for possible incorporation into their Alpine mountain ranges. Several compositional variations were presented to Cameron in low-resolution form so that he could choose from them.



A shopping mall restroom – built on stage at Santa Clarita Studios – was the setting for a major brawl and Shootout between Harry Tasker and members of the Crimson Jihad terrorist faction. Studying playback of an earlier take, Cameron blocks out fight choreography with star Arnold Schwarzenegger.

Don Pennington and crew were already immersed in producing sturdy fiberglass castings from the Harrier molds. "Once we had the skins made and laminated them together, we were able to take measurements for the steel substructure. The airplane was forty-seven feet long and had a thirty-foot wingspan – and it had to be very strong since it was going to be tossed around and hung off wires and people were going to be climbing all over it. Roland Lowe was my metal man on this project and he did an excellent job. The framework was made out of box tubing, with station line bulkheads connected by stringers and a central spar that went all the way through the plane. The fuselage was designed to come apart in three pieces, and the wings and tail were removable. The skins were either laminated or bolted to the frame."

Wherever possible, actual Harrier parts were procured as salvage from the Marine Corps maintenance depot at Cherry Point, North Carolina. "We got a cockpit from a Harrier that had ruptured a fuel cell during a hard landing several years ago and caught fire. Anything that was still usable inside had been stripped out – which was everything but the seat rails – so we had to simulate all the interior detailing. Fortunately, we were able to get a real ejection seat – once one is used, it cannot be put back into a flight-ready aircraft – so that was a big help. But other than that, everything in the cockpit was scratch-built – including all the instruments and gauges which we generated on a computer from photographs. Jeremy Bishop and Michael Wheelwright did a lot of that cockpit detail." Enclosing the cockpit were an acrylic canopy and windscreen, also procured from the Marines. Other salvage items included the plane's outrigger gear and rear main landing gear. Though no Harrier nose gear assembly was available, Pennington was able to substitute one from an F-8 Crusader and modify it to match. "I wanted to use real gear because I knew it would take a beating – and it did."

A McFadden Systems six-axis Model 648A motion base-rated for a maximum payload of 14,000 pounds – had been selected to insure fast and fluid movement of the 7000-pound airplane. "The system has six hydraulic cylinders with feedback sensors that are state-of-the-art," explained Noel. "Each cylinder has a forty-eight-inch stroke. With the geometry of a motion base, that gave us fifty-eight inches of vertical heave and five feet of movement in any direction. It also allowed us sixty degrees of tilt in any direction. And the speeds were incredible." Atop the hydraulics was a dynamic platform, built principally by Terry King, to which the airplane was affixed. "Because the production wanted to be able to roto-scope out or digitally remove the motion base, what actually went up into the plane was a ten-inch-diameter steel pipe that was welded in place. A huge ring bearing allowed us to rotate the plane in relation to the platform." Noel and crew also built the base on which the platform and hydraulics would sit – a three-ton steel triangle measuring about twelve feet on a side.

Like the *Jurassic Park* tyrannosaur, the Harrier could be controlled manually in real-time or programmed on set for precise repeatability. "Ron Goldstein handled the whole computer side of things. He and I built a waldo, which was basically a twelfth-scale version of the motion base. Rather than put a model plane on it, we used bicycle handlebars oriented like the wings would be. To do a pitch and roll, all we had to do was grab the handgrips and make the move. If we moved the waldo an inch, the plane would move twelve inches."

Once the motion base was ready and the plane nearly finished, both were transported to the Syncro Hangar for four days of intensive testing aimed at eliminating the likelihood of unhappy surprises when production commenced in Miami. Detailed down to the last rivet, the Harrier had only to be

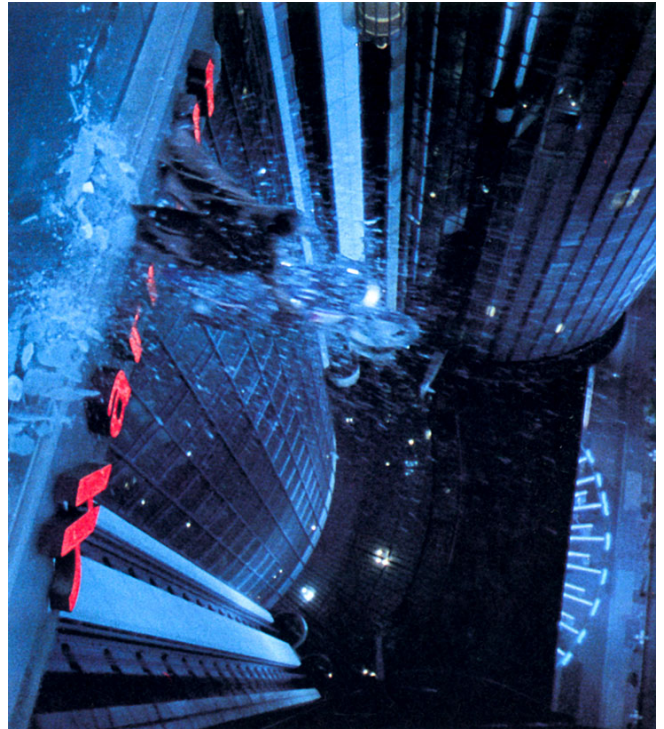
painted before its departure. During one of his trips to Cherry Point, Pennington had been taken to the flight line and shown one of the Harriers the *Marines* intended to provide for the live-action shoot. He photographed it thoroughly, paying particular attention to weathering details such as exhaust smudges and dirt patterns baked into the blue-gray finish. When it came time to paint the mockup to match, Pennington gave Ted Van Doren the task. "Ted used a lacquer as a base and then a two-part urethane clear coat for protection. We knew people were going to be all over the plane – all the time – so we had to make sure the paint wouldn't scratch easily or pick up footprints."

The completed mockup, in six major pieces and about two dozen lesser ones, was transported to Miami in early November. Once there, it was hoisted to the roof of the Interterra Building by the huge construction crane erected months earlier to serve the production in a multiplicity of roles. "The crane was both a prop and an essential piece of equipment," said Peter Lamont. "It would have been impossible to get everything we needed up the building's elevators, so most of it was lifted from the street by the crane. Just to get it on the roof, we needed an even larger, mobile crane on the ground. To justify the crane's presence, Jim wanted the building to look like it was still under construction; so we built a large deck out of tubular scaffolding and plywood that fit around the elevator housing and expanded the surface area on top."

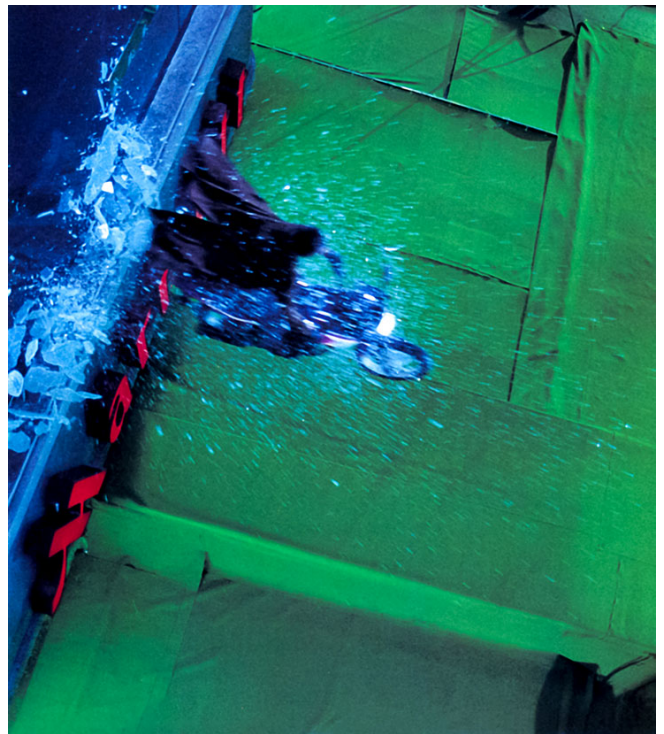
Pennington and crew assembled the Harrier before mounting it to the motion base. "The production," stated Noel, "had contracted with some local engineers to bring three pieces of steel up through the roof of the elevator housing – just extend the structural steel already in the building – and we welded our base right onto those. To further absorb the load and reinforce the building, the engineers ran sixty-four screw jacks through the roof to the floor below."

Although the rooftop deck was undoubtedly an ideal vantage point from which to photograph the Harrier, its limited surface area had been determined problematic – especially for an action director whose camera was seldom at rest. The platform was too small for a large camera crane and too crowded to support much track. Even Steadicam use would be limited because of the aircraft's height off the deck. The solution would be a Technocrane.

Normally affixed to a small dolly, the compact Technocrane features a telescoping arm that can extend from six feet to twenty, enabling it to duplicate track moves and traveling crane shots from a fixed position. It can pivot horizontally and vertically – eliminating characteristic arc, if desired – and support a full range of cameras on an electronic remote head. Aware that only a single Technocrane unit existed in the United States, the production moved quickly to book it through company principal Simon Jayes. "Before long," said Jayes, "somebody realized that the Harrier canopy at its lowest was still going to be seventeen or eighteen feet off the deck. The Technocrane, in normal use, has a lens height of only twenty feet, so that would have given us very little range of movement. There was talk about putting it on a raised platform; but then I think it was Jim Cameron who suggested, 'Let's just hang it from the construction crane.'"



Attempting a reckless escape from his pursuers, Aziz crashes his motorcycle through a glass railing and off the roof of a thirty-story hotel.

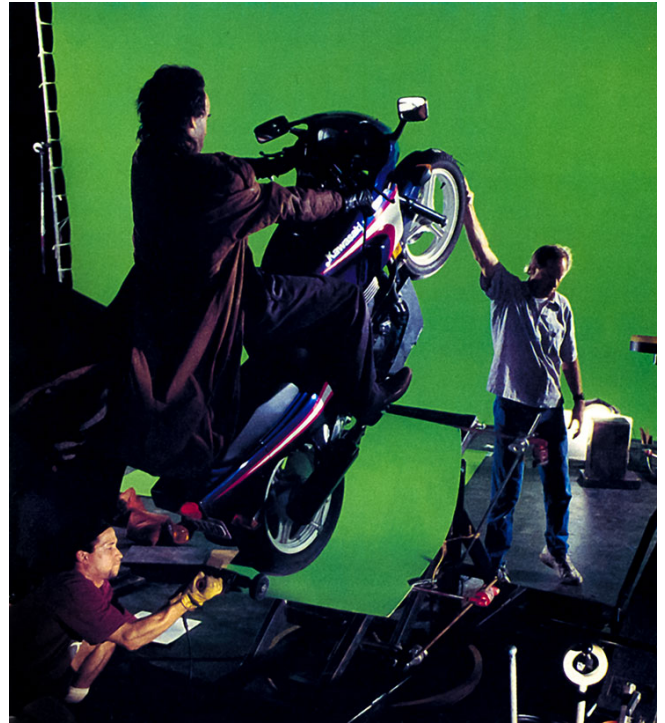


Stuntman Jimmy Roberts performed the leap from an elevated set onto a ramp covered with greenscreen material. Boss Film Studios assembled the shot digitally.

Though he thought the idea outlandish at first, Jayes and partner Mark Hotchkiss were soon addressing the challenge. “We came up with an enclosed platform – big enough for four people – that fit around a hook dolly on the construction crane so it could roll up and down the full length of the boom. On the bottom was an upside-down post from which the Technocrane was suspended. Pan and tilt controls for it were operated by grips turning steering wheels that came up through the floor. One of my guys – also on the platform – controlled the extension and retraction. The camera was operated remotely from the roof.”

Under the direction of John Bruno, a one-week shakedown period preceded the arrival of the full production company. “Our job was to test everything and work out the bugs – try to break anything that might break later on. We rehearsed all the action, figured out where the camera and the crane and the plane needed to be for each shot, and basically photographed all the storyboards using members of our crew as stand-ins for the actors. That way, when Jim arrived, we would have everything plotted out as much as possible. It was a trick getting the action together with the right background, because the Harrier wasn’t supposed to be on the building. It was supposed to be a few hundred feet away, over the street, and we had to pick our angles so it looked that way.”

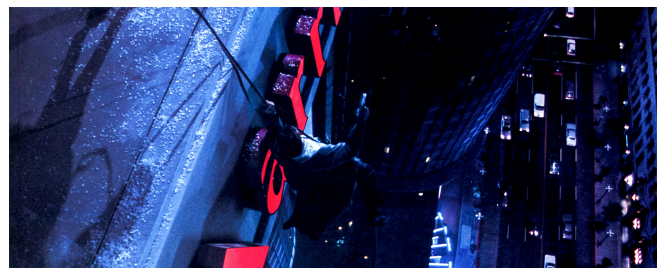
The first day of actual rooftop shooting was especially harrowing for Mark Noel who, in addition to overseeing the motion base and its operation, had been charged with constructing a propane gun that simulated the Harrier’s rapid-fire cannon by spewing eight-foot bursts of flame. “Here we were on the first day, and I was getting: ‘Okay, we have Arnold in the cockpit. I want you to do a big pitch and roll movement and fire the gun.’ Everything was tightly controlled, safety-wise, but I was like: ‘Can’t we do this on the sixth or seventh day when I’ve had a little practice?’ We were still just getting the hang of things. We hadn’t figured out, at that point, how to



For a follow-on shot of the motorcycle flying through the air and into a rooftop swimming pool across the street bike and rider were placed on a mechanical tilting rig and photographed on stage at Boss.



That greenscreen element was then composited into a background plate that was itself a composite of several live elements, as no suitable building could be found with a rooftop pool.



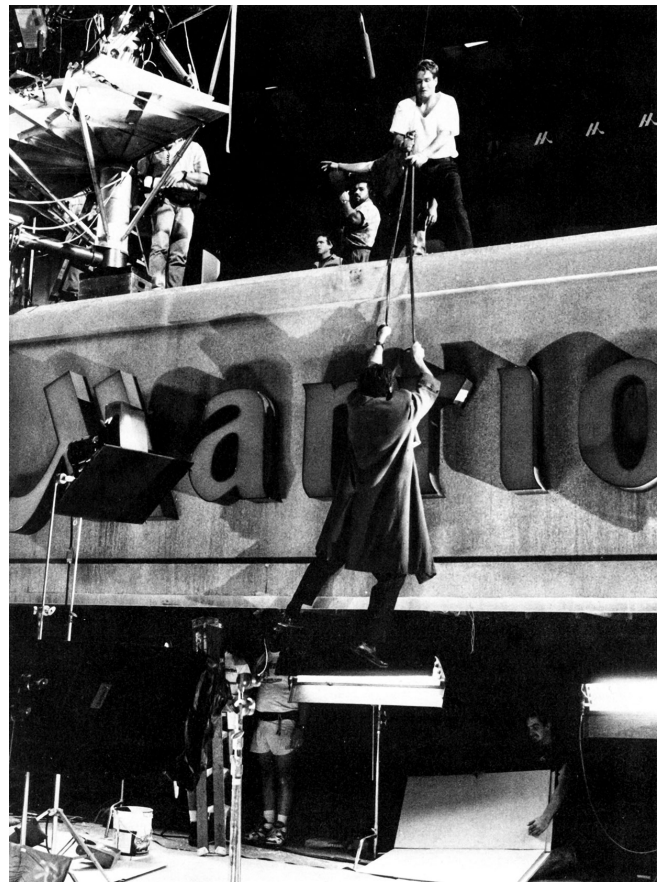
Harry attempts to follow, but is left dangling off the side of the hotel when the horse he is riding balks at the leap.

lock the plane into position; so I'd be holding it steady by hand for five or ten minutes at a time and getting massive cramps in my arms. I was pretty much a jellyfish by the time I left that day."

Although most of the motion base moves were performed manually and in real time, a few situations dictated that they be programmed in advance. "There was a scene where the tail of the plane was supposed to hit the crane. We didn't want to damage either the crane or the mockup; so we programmed a sharp yawing move on the plane that we could repeat over and over. Then the crane was positioned so that the plane came very close, but did not actually hit it – it just looked that way to the camera." Another application was used to get performers in and on the plane. During the shakedown, Bruno had determined that much time would be wasted if lifts or ladders had to be used for this purpose. To expedite matters, the plane was programmed to tilt forward severely so that the nose nearly touched the roof. From that position, the performers could get on and off safely and easily.

As anticipated, Cameron used the highly maneuverable Technocrane almost exclusively. "The way the crane was mounted allowed us an up-and-down range of about thirty feet," said Jayes, "which meant we could move from well above the jet to well below it. As a result, we were able to do things that could not have been done any other way. If we had been down on the deck with the airplane, for example, we would never have been able to get very far away from it. But since we were on this big construction crane, we could swing way out over the street and look back at the plane. It was like having an enormous dolly at our disposal. And even though we were riding on the construction crane, we could move out and away from it and shoot both the jet and the crane. We even painted our platform yellow to match the crane in case it ended up in a shot. It was such a 'one-of' rig that it looked like it might have belonged there."

One of the early shots in the sequence had Aziz, on the construction crane, empty his AK-47 into the hovering Harrier, blasting out its canopy and windscreen. Although the three-quarter-inch-thick lexan used to enclose real Harrier cockpits could easily withstand such close-range weapons fire, it was determined during preproduction that license was required, more for logistic reasons than artistic. "When we were doing our tests in L.A.," noted Bruno, "the scariest thing I found was that there was no way to keep the surroundings and stage lights from reflecting into the canopy. So I went to Jim and said: 'If we get this on stage with a full canopy,



Arnold Schwarzenegger is filmed hanging off the edge of the elevated rooftop set built in a hangar at Van Nuys Airport. Beneath him is greenscreen material. Vertiginous backgrounds of the street far below were assembled from plate footage shot by the Digital Domain effects crew off rooftops in downtown Los Angeles. Compositing of the shot was accomplished at Boss Film Studios.

we're dead! It'll cost us a million dollars to take these lights out in post – and I'm not even sure we can do it. It's the one thing that'll make this sequence look fake.' He said, 'Well, what are you suggesting?' And I said, 'That we shoot the canopy out.' So that's what we decided to do."

But on the rooftop – delayed by weather and the complexity of the shoot – Cameron came close to reversing the decision. "The canopy shot was going to be done live," Bruno explained. "Tommy Fisher and his people had prescored the lexan and rigged it with dozens of bullet hits – we wanted the canopy to shatter like glass and disappear in one shot. But it didn't. The material is so strong that it held together. Jim said: 'That's it. It's staying in. We're moving on.' I could see disaster on the horizon. I said: 'I know you're upset, Jim, but don't do this to yourself. You'll hate it when we get on stage. Let us carve up the canopy by hand the way we want it to look. Then we'll go back later and do the blow-out as an insert.' Fortunately, it was late in the day and he said okay. So I was on the roof until one in the morning with Don Pennington and the effects guys, hacking away at the Harrier canopy with saws and whatever else we could find that would cut it."

Shooting proceeded at a maddeningly slow pace due to mercurial weather conditions. Skies changed from cloudless blue to ominous gray – sometimes in mere minutes – making it difficult for Russ Carpenter to match lighting and backgrounds. Even more distressing were the thunderstorms that rolled through the area with disturbing frequency. A lightning sensor – designed to provide a few minutes' warning in the event of a likely strike – sent the crew of one hundred scurrying off the roof on a number of occasions. "Jim was getting pressure from the studio," recalled Bruno. "There was a lot of nervousness about having all these people up on the roof. He and I would meet at 5:30 every morning and go over the storyboards and the shots, trying to figure what we could do later with greenscreen or miniatures." Cameron did manage to buy himself an additional roof day, however. "We knew that when we finished on the roof we would have to use the crane to lift the Harrier off the motion base and lower it to the street. So it dawned on us that when we were lifting it off the base, we could put stunt people on it and get a few wide shots of them fighting. The cables and wires we could remove later. That turned into, 'Well, maybe we could hang it over the street and shoot it from a moving helicopter.' By doing that, we could eliminate six or seven complicated composites and save a lot of time on the greenscreen stage."

After first determining that the Harrier could be flown as proposed without compromising safety, Bruno discussed the scenario with stunt coordinator Joel Kramer who gave it his enthusiastic endorsement. "The idea was conceptually way out there," said Bruno, "but Jim got the studio to give him another day to get those shots. So once we were finished on the roof, the Harrier was lifted off the motion base and lowered to the street where stunt people climbed on and were safety-cabled to it. Then it was hoisted back up, some two hundred feet above the street. Jim was circling in a helicopter, shooting from there; and I had Vistavision cameras on the Interterra Building and across the street on the Capital Bank Building."

Inside the cockpit was stuntman Billy Lucas. Though similar in build to Arnold Schwarzenegger, his jaw was not as angular, and so foam latex appliances were routinely applied by makeup artist Jeff Dawn to enhance the likeness. Cabled onto the fuselage was fellow stuntman Jimmy Roberts whose facial appearance was likewise altered with the addition of a forehead piece that rendered him a passable double for Art Malik. Secured onto the nose of the plane in place of Eliza Dushku was the diminutive Kim

Zimmerman, whose background was the circus. “The stunt people really got into it,” said Bruno. “The action started with Jimmy jumping onto the back of the jet, crawling his way up to the cockpit and going after Billy with a knife. Meanwhile, Kim was hanging and slipping off the nose and Billy was grabbing for her and trying to pull her back up as he continued struggling with Jimmy. It was about thirty seconds of action, and it was shot over and over. All the while, the stunt people were getting more and more comfortable with it, really acting it out and rocking the jet. At one point, Jim decided he wanted the plane spinning, and they were like: ‘Sure. Go ahead and spin us.’”

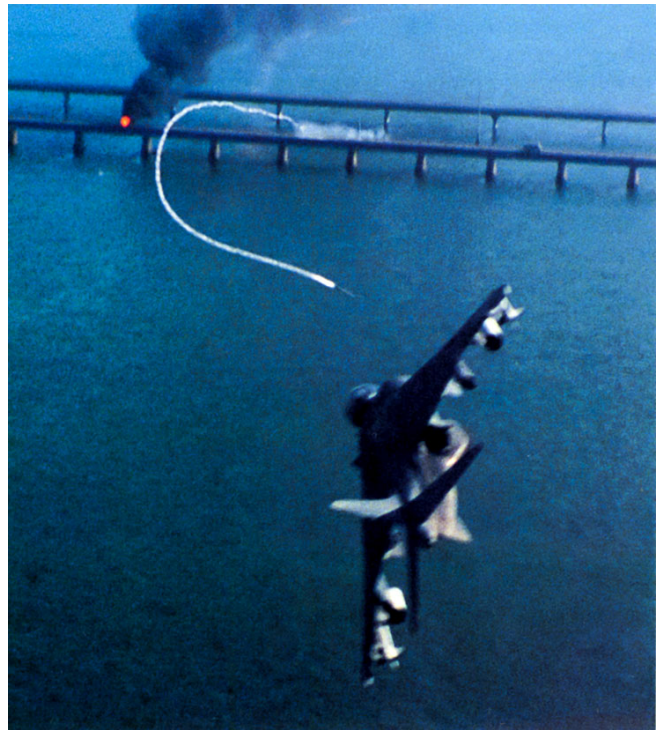
To that point, the plane had been suspended from a single steel cable, with two wires extending off the tail to the rooftop to stabilize it and keep it facing in the right direction. Another approach was needed to make it spin. “We brought the plane back down to the street,” said Don Pennington, “and put 300-foot-long puppet cables on it – one on each wing and one on the tail. Then the plane was whistled back up to the top of the building. Jim would be up there on a loudspeaker and six of us would be down below manning the ropes; and he would say, ‘Okay, give me rotation.’ And we’d start running around in a circle, tugging on the airplane. ‘Faster! Faster!’ he kept going. ‘Faster!’ Well, you know, this is a 7000-pound plane – it takes a while. We must have rehearsed the scene five or six times and then Jim took about six or seven takes. Each time, we would have to get the plane up to *Speed* and then stop it – and then do it over again. It was about a hundred degrees that day and we were really dogged.”

Once the desired footage was attained, the Harrier was lowered to the street and rigged for its next scene in which Harry lands the jet with Dana still clinging to the nose. “We wanted a big wide shot for the landing,” said Bruno. “The burning wreckage of the helicopter is on the street and firemen are trying to put out the flames. Smoke is everywhere. People are running all over. And in the midst of all this, the Harrier just flies right down Brickell Avenue and lands in the street.” To achieve the shot, the Harrier mockup was attached with a single cable to a seventy-foot truck-mounted crane and lowered onto the street with a slight pendulum move so that it rolled forward a few feet and then crunched into a parked police cruiser. After several rehearsals with the stunt performers, Schwarzenegger climbed into the cockpit and Dushku was secured to the nose for the actual take.

From Miami, the production company headed south to the Florida Keys for scenes leading up to the climax just completed. Harry and Helen have both fallen into the hands of the Crimson Jihad and are being held captive on one of the small keys being used as a staging area by the group. As a sign of their determination, the terrorists set one bomb to explode on the remote island, with the promise to detonate three others in major U.S. cities if their political demands are not met. Loading two other bombs into trucks and a third into a helicopter, the terrorists depart the island, even as their captives escape and begin wreaking havoc on the compound. Helen is recaptured and shoved into a limousine that heads up the causeway after the trucks. Harry calls for backup and two Marine Harriers respond to the national emergency by blowing up a bridge span and destroying the trucks. A pulse-pounding rescue then ensues as Harry – hanging from a helicopter skid – plucks Helen from the speeding limousine just moments before it plunges into the breach.



Harry calls in the Marines to interdict a terrorist convoy which is transporting nuclear weapons along the Overseas Highway connecting the Florida Keys to the mainland. Two operational Harrier warplanes flew training missions in support of the production – and for a simulated air strike on the convoy, Maverick missiles affixed to their wings were replaced with digital replicas that spewed out computer generated exhaust trails.



One of the Harriers takes evasive action to avoid a Stinger missile fired at it from one of the trucks.

The stunt was shot live on a section of the old Seven Mile Bridge, which had been decommissioned in 1982 when a new bridge was completed next to it. A span which had once been a turngate to allow ship passage through the Moser Channel had been removed at that time – and the opening it left proved fortuitous to the film company. “We got permission to use a section of the old bridge between Pigeon Key and the Moser gap,” explained Peter Lamont. “The idea was to dress the breach as though the bridge had just been blown away, so that when the limousine went off the edge there would be smoking wreckage in the water below. We built a model, and Jim smashed it up the way he wanted it. That became our blueprint. We were very lucky, because when Bob Laing – the art director in charge of that segment – went to Miami to do a scout, he found a spot on the Miami River where a complete bridge had just been dismantled, and we were able to rent the remains. We got two large barges and assembled the bridge pieces on them so that they looked the way Jim wanted. Then we floated them down river and sank them off the end of the bridge so that only the wreckage showed above the water. When the sequence was finished, we pumped them full of air and floated them back up.”



As the Mavericks home in on their intended targets, the Harriers veer off to avoid debris from the anticipated explosions. Digital Domain provided the missiles and exhaust trails.

Following their successful missions, the Marine warplanes and the Omega Sector helicopters land on a section of the causeway near Marathon. Here the Pennington mockup – restored to pristine condition after the Miami Shootout – was attached to yet another flying rig for a sequence in which Harry commandeers the Harrier and jets off to rescue Dana. Though he has flown the plane before, Harry is a bit rusty at the stick and the takeoff is anything but textbook. “What we needed,” said Mark Noel, “was a way to fly the airplane from a crane and give it some pitch and roll and yaw. So we built a three-arm mechanism that rotated on a bearing driven by a hydraulic motor. Tim Moran did the fabricating on that. Then there were three cables that ran off three-foot hydraulic cylinders that were compounded to produce six feet of motion. That meant the plane could go up and down six feet, and we could pitch it and roll it and rotate it. The control system used feedback proportional hydraulics, and Ron Goldstein operated it from the ground with an inverted waldo.”

Wrestling with the unfamiliar controls, Harry pitches forward and drives the Harrier’s front gear up the hood and windshield of a parked police car. “That was a complex shot because there was actually very little contact between the plane and the car,” observed Noel. “Tommy Fisher cabled the car so it could be sucked down when the plane rolled up the hood. The windows were rigged to blow and the light bar on top was set to collapse. Four wind machines were positioned to simulate jet blast. The crane operator had to swing the plane in on the right trajectory while Tim Moran worked the controls for yaw. Amazingly, we got it on the first take. It was like a gift.”

Although real Harriers had overflown the Seven Mile Bridge in mock attack, it was up to the Digital Domain effects team to deliver the ordnance. It was clear that a large-scale miniature was required, but exactly where to place it was not so evident. “We considered several alternatives,” John Bruno

commented. “There was the tank at Universal, which would not really have been big enough, and there was the Salton Sea where some of *The Abyss* was done. But there was something about the Florida Keys – the lighting and the sky and the water – that would have been impossible for us to duplicate anywhere else. Plus the water there was shallow and there were no waves – which made it great for maintaining scale in miniature.” As it turned out, there were waves, but of a patently bureaucratic nature. “Getting permits to shoot in the Keys was a *Nightmare* – especially when rumors started circulating that Jim Cameron and Arnold Schwarzenegger were coming to Florida to blow up the causeway. We spent several days with the state environmental people looking for suitable places to put our bridge. There were all kinds of restrictions. If there were coral heads or sponges or turtle grass – which was just about everywhere – no one wanted us working in those areas, let alone blowing things up.” Temporary sanction was finally granted for a secluded spot off Sugarloaf Key near the terrorist compound site.

Though Pat McClung – a veteran of *Aliens* and *The Abyss* – had been hired to supervise the *True Lies* modelmaking effort, his first few months on the film had been limited to planning and budgeting out of an office at Lightstorm Entertainment. “We were closing in on the date when we needed to start building things, and Digital Domain was still without a facility. Even with one, it would have taken a while to get a model shop up and running from scratch, so we started talking about farming out some of the work – specifically the bridge.” High on the list of prospects were Mark Stetson and Robert Spurlock of Stetson Visual Services.

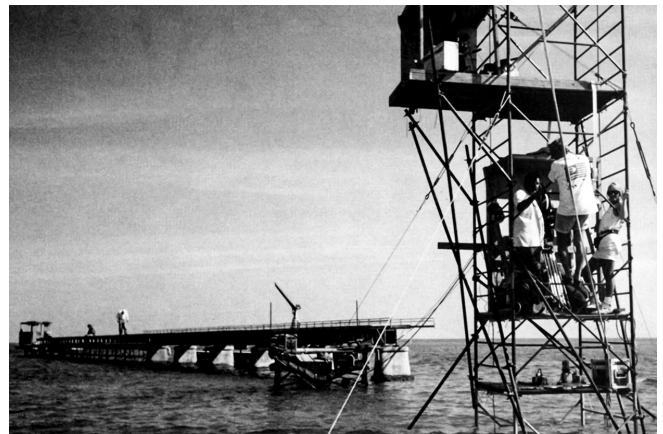
After a trip to Florida to examine the location, the partners were awarded the construction contract and given seven weeks to produce and deliver a five-span miniature of the old Seven Mile Bridge. Although bids had been considered for third- and fourth-scale replicas, economics dictated a fifth-scale compromise. Even at that, the model would be nearly two hundred feet long – eighty of it a fully detailed rendering of the bridge and the remainder just scaffolding to support enough track to get a truck model up to speed. “Peter Lamont came up with a beautiful model that showed us how he was going to assemble his debris around the real bridge,” noted Spurlock. “The tricky part for us was designing our bridge so we could blow it up and have the remains look just like his afterward. Les Ekker and John Stirber – our crew chiefs – built a small tabletop model to work out mechanically how the pieces needed to fall or be pulled down. John Bruno kept saying: ‘I just want to blow the shit out of it – vaporize it!’ He and Jim Cameron loved that Gulf War footage of the ‘Luckiest Man in Baghdad’ – the guy seen driving his truck across a bridge as the bridge obliterates right behind him. They really liked the look of that – a lot of explosive power, but not a lot of flame. And they liked the shock waves on the water.”

A wide range of materials was employed in fabricating the bridge. For maximum strength and rigidity, the six stanchions supporting the structure were made from welded steel covered with sturdy half-inch-thick fiberglass facings painted to look like concrete. Spanning the sixteen feet between stanchions were dual trusses made principally of aluminum stock, but with breakaway fiberglass sections where the explosions were to occur. Lead sheeting covered the trusses. The road surface varied depending upon placement. For the outer spans, which were to remain largely intact, plywood was the material of choice; but for the impact areas, prescored sheets of masonite were sandwiched with plaster, top and bottom. Countless tests were conducted by modelmaker Adam Hill to develop a faux-concrete plaster that was insubstantial enough to 'vaporize' on detonation, yet dense enough not to float on the water. Scott Schneider fashioned railings from lightweight aluminum covered with flexible cast urethane.

While the bridge construction was in progress, a separate team was building two like-scaled replicas of the terrorist's panel truck, together with the mechanisms needed to propel them to their fates. "Henry Gonzales was in charge of the truck shells," stated Spurlock, "and his crew took a lot of pains to make them look as real as possible. The truck body was sheet aluminum and bondo and the cab was carved and cast in plastic. The fenders and grille and lights and mirrors were all as accurate as they could be. Chris Cowan and Richard Stutsman designed the undercarriage – which was made of steel and quite sophisticated. Between the wheels and the chassis, they built swing arms and put in small shock absorbers and a pneumatic suspension so that the truck body would react to any dips in the road. The wheels were high-speed steel casters – the kind used on roller coasters – and the tires were solid rubber. Just behind the front wheels, in the center of the truck, was a tongue that came down and followed a groove in the run-up track. Inside the groove was a channel with a cable that led from a motorized winch up to where the track and the bridge met. About halfway into the bridge, the groove stopped. When the truck hit that stop, the force of it was enough to snap a bolt and a piece of wire that folded the tongue back up. Then the truck just went wherever it went."



The terrorist trucks are crossing the Seven Mile Bridge when the Mavericks strike. For the devastation that follows, Stetson Visual Services constructed an eighty-foot miniature representing five complete bridge spans. To insure that sky and water and lighting matched that of the main unit location, the model bridge was transported to the Florida Keys and erected in a shallow cove. Pyrotechnicians Joseph Viskocil and Emmet Kane thread primacord through plastic tubing incorporated into the miniature.



Scaffolding extending from the bridge supported a runup track for a model truck that would be blown to bits while speeding across the expanse. Six high-speed cameras in three locations recorded the destruction.

Engaged to execute the small-scale demolition work was Joseph Viskocil, no stranger to Pat McClung or Stetson Visual Services whose meticulous miniatures he had been decimating for years. Providing additional explosives expertise was Emmet Kane, whom Viskocil often enlisted on big assignments. *True Lies* would be one of their biggest.

Preparation and testing is vital to any pyrotechnic endeavor, especially when the opportunity for retakes is limited. Though the effects team would have been more at ease knowing they had bridge and truck replacements to support three attempts, the size of the causeway miniature and the complexity of the rigging determined that only two would be feasible. “We did our tests in two phases,” related Viskocil. “First we went out to Disney’s Golden Oak Ranch in Newhall and spent three days shooting film tests on a rough twenty-foot bridge section that Stetson had built. The bridge was on dry land – not over water – but those tests were useful in determining what pyrotechnics to use and how fast the cameras should be running. Since the truck was going to be moving too fast for me to detonate the bridge properly by eye or by hand, Bob Spurlock and Richard Stutsman suggested having the truck itself set off the explosions. That necessitated a whole different set of tests, which we did in a large parking lot at the Hughes Aircraft facility in Marina del Rey.” Constructed for the truck tests was a sturdy mockup made of steel and plywood, which was propelled repeatedly across the asphalt at about forty miles per hour. “I rigged three monofilament trip lines – one for each explosion – and when the truck hit them, it would pull a pin, making circuit contact with a battery. During the actual shoot, that would set off the explosives; but for the tests, I just used flashbulbs. The first two blasts needed to go off three or four feet behind the truck, but the third one was going to detonate underneath it.”

In late October, Stetson Visual Services hauled the bridge in pieces to Sugarloaf Key where final assembly and detailing was to be completed at a base camp established by shop foreman Sarkis Hardy. Though the production had been working with twenty-seven different state and federal agencies for months, filming permits had still not been issued and resistance to shooting in the Keys was mounting among local environmentalists. “The site we had selected was ultimately disapproved,” said Stetson, “and we had to go three hundred feet farther out to a spot that had a predominantly sandy bottom. That was a problem for us because the bridge had been built to sit in about three feet of water. Now the water would be four-and-a-half feet deep at one end of the bridge and over our heads at the other. Also, we had proposed building a temporary dock so that we could haul things out from shore and load them onto pontoon boats. No way. To build anything at all, we would have had to build to code for a permanent water structure – which meant going out to a four-foot low tide to eliminate the possibility of prop wash from our boats. We would have needed a five-hundred-foot dock to do that. So we had to stage from the live-action base camp – which was less than a mile away, but it added another half-hour to each round trip.”

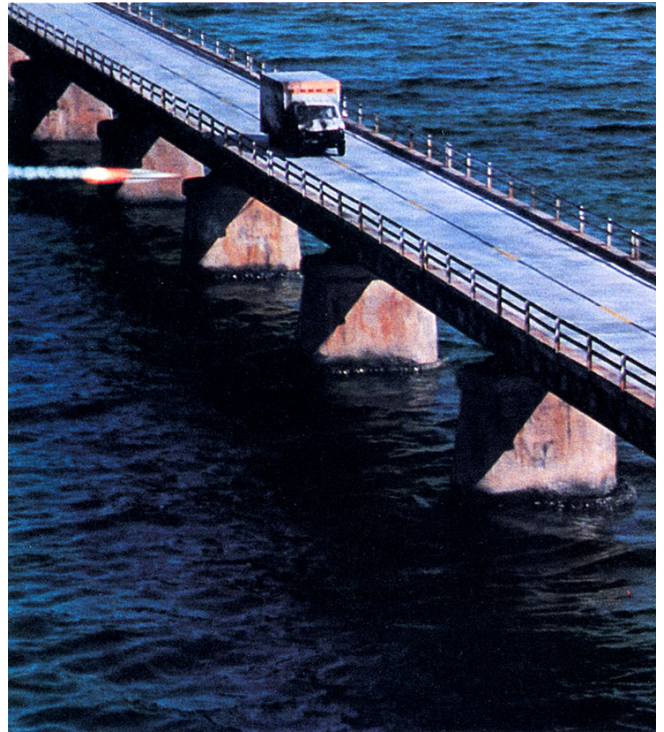
Resigned to the conditions of their permit, the twelve-man Stetson crew – augmented by Pat McClung – set about modifying the bridge for placement in deeper water. “John Stirber had built each pylon with four adjustable legs so we could level them on the bottom,” stated Spurlock. “But we were thinking inches – not feet – so we had to add on to them, which took almost two weeks. Also, the fact that we were now in deeper water with a taller structure made it more difficult to anchor everything securely. We put eight hundred pounds of weight-lifting weights on each leg to

make the pylons rock solid, and we ran cables into the ocean floor as if we were staking down a tent. And, of course, a lot more of the work now had to be done with scuba gear or a hookah line.”

A small flotilla of skiffs and pontoon boats transported the bridge sections from the base camp to the approved installation site. “The hardest thing,” said Spurlock, “was aligning the six towers all in a straight line at the same elevation. Four of us in the water would lift the pylon – which weighed two or three hundred pounds – and kind of feel the bottom as we maneuvered it around. A transit was needed to line everything up. Then we brought in the trusses and bolted them to the stanchions. Once those were in place, the structure was a lot more rigid. Next we brought in the road sections – those were about eight hundred pounds apiece – and positioned them with a crane off one of the pontoon barges. The final step was painting. Ron Gress matched the real bridge beautifully – right down to the rivets and rust stains and corrosion – and we glued on a lot of surface texture like barnacles and seagull nests.” Assembling the off-camera truck run-up was a much simpler process, though the scaffolding, it was discovered, had to be purchased outright since none of the rental houses normally supplying it wanted their property immersed in sea water for weeks. In the end, with delays attributable to modifications and bureaucratic red tape, the anticipated three-week preparation period extended to nearly six.

By the time all was in readiness it was early December. One last detail had to be addressed before the shoot could proceed. The terrorists’ truck was still in pristine condition since the live-action leading up to the bridge explosion had not yet been filmed. To get a definitive reading on how distressed it needed to be, Ron Gress and Les Ekker loaded the four-foot model into a car and drove thirty miles to the Marathon location where the first unit was shooting. “They met with Julia Gibson,” stated Spurlock, “and showed the truck to Jim Cameron between setups. Jim really liked it, but he said, ‘You know, we’re going to have to smash up the front.’ He asked what the material was, and Les told him it was lead. A big smile came over his face, and he said, ‘Somebody get me a hammer.’ And he just started wailing away on this thing. He hammered in the front fender and bumper, drilled into the windshield where bullet holes were to be and used a marker to show where fire was going to leave black soot along the side and top of the van. Julia said he was in heaven.”

Following weeks of picture-perfect weather, the shoot was scheduled and then postponed a day when high gusting winds created scale-busting whitecaps in the normally placid cove. The next morning, three high-speed cameras were hoisted onto a scaffold platform about thirty feet from the bridge. One – operated by effects director of photography Mat Beck – was at the top of the twenty-foot-tall platform. Next to him was a locked-off camera. Directly below was a third camera manned by Mark Brown. Off to the side – on a separate scaffold – was a fourth operated by Wayne Baker. Shielded by plexiglass, each cameraman was primed to follow a specific part of the action. A fifth camera was positioned at water level only about ten feet from the bridge. “We built a watertight box out of plywood and fiberglass, with a lexan front to shoot through,” explained Beck. “The box was clamped to a scaffold and weighted with hundreds of pounds of lead shot to overcome its natural tendency to float. With the camera inside, there was just enough room for me to scrunch in and line up the shot. Wayne Baker rigged a couple of little air blowers to keep debris and water spray from obstructing the lens. Once positioned, the camera was locked off and operated remotely from the main platform. It was a really dramatic angle.”



The cut sequence was delivered to Digital Domain where digital artists added computer generated missiles and exhaust trails in advance of the detonations.



The first Maverick impacts behind the truck.



The second blast was recorded by a remote camera shooting at water level from a watertight box. Bridge surfaces were covered with layered plaster designed to resemble concrete when pulverized.

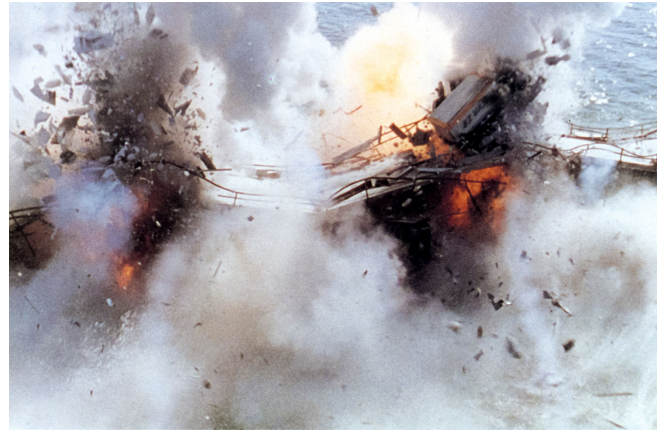


The third Maverick barely misses the truck as the fourth zeroes in on it. To make the computer graphics look integral to the shots, the missile trails were animated to dissipate appropriately when struck by shock waves emanating from the explosions.

Rigging of the explosives was accomplished from pontoon platforms lashed together and tied to the bridge, then towed away just prior to the shot. “The bridge explosions were basically primacord and gas bombs,” said Viskocil. “The gas bombs would be the first to go – those would produce a bright, hot-orange flash – then everything would be blown to smithereens by the primacord. We used about a hundred feet of 50-grain primacord and about two hundred feet of 100-grain primacord – which is a lot of explosives for a miniature. Primacord is ideal for our purposes, because it can be handled safely and easily and is very stable. When it’s detonated, the charge travels at 23,000 feet per second – which makes it practically instantaneous. The gas bombs were standard mortar-type deals – six ounces of gasoline in a condom, with a small charge to vaporize the gas and ignite the fireball. We also used eight explosive cable cutters, because the bridge was rigged to come apart in a very specific way and much of it was held together with cables. When the cables were cut, predetermined sections would collapse as planned.

“The Stetson guys made it easy for us by building vinyl tubing right into the model. All we had to do was lace the primacord through it. As soon as we got the primacord in place – but before the detonators were installed – they came in with their plaster shells and lead sheeting and did the finishing work. After that was done, I would run everyone out of the area, leaving just Emmet and me to get the detonators on the primacord. The very last thing we did was put the gasoline into the mortars. I ran my leads underwater to the camera platform where I had a clear view of the bridge. Just before the take, I would hook up the wires to a battery. Now we were hot. But in case the truck made a wrong turn or a pelican decided to drop in and trip a wire, I had a fail-safe box at hand so I could shut the entire thing down immediately.”

Before the explosion could proceed, a state environmental representative was sent up in an ultralight to search for turtles or manatees in the area. Finding none, the go-ahead was given. Mike Chambers ordered cameras to be brought to *Speed* at frame rates ranging from 120 to 144 frames per second. “Jim wanted the explosions to look slightly slow-motion,” Beck recalled, “because that’s how he would have shot them if he’d been doing it full-size. That’s where our work in L.A. really paid off. You can do the math to figure out frame rates for miniatures, but truck speeds and explosions and water all have their own variables. So we shot the tests and went with what looked best for each angle.” Nevertheless, as is frequently the case in miniature work, take one was to be an elaborate dress rehearsal. On cue, the bridge was detonated. Three spans collapsed into rubble, the truck tumbled into the breach and the center pylons were obliterated to the waterline. In dailies the next evening, Cameron expressed general satisfaction, but ordered a second take with a few changes. Specifically, he wanted the final charge increased in size and repositioned so that it went off more



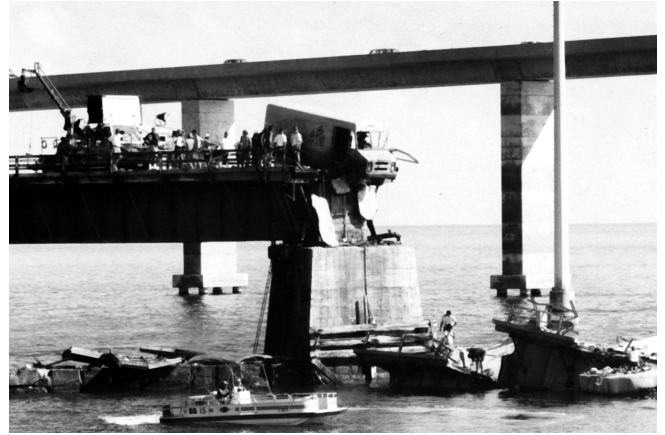
The final explosion erupts directly under the truck. During the shot the truck model unexpectedly pirouetted skyward and landed back on the bridge, across the rubble-strewn breach – creating spectacular footage, but also raising a continuity issue which had to be resolved with additional effects shots.

directly under the truck. He also authorized a sixth camera – manned by Chris Duddy – to cover the action.

It took the Stetson crew only two days to rebuild the bridge. On the second shoot day, confidence was high, but nerves were on edge since everyone knew there were no additional bridge sections for a third attempt at perfection. Cameron – who had been shooting elsewhere when the first blast was effected – showed up to observe the second. “To his credit,” commented Bruno, “Jim was nice enough not to check every camera angle. He told me: ‘Go ahead. I’m just going to watch with everyone else.’” Not without first doing a little reconnoitering, however. “I was on the camera platform hunched over my controls,” recalled Viskocil, “when, all of a sudden, some guy climbs up the back side of the scaffolding and plants his big foot right on one of my batteries. Without turning around, I said, ‘Oh, please don’t step on my batteries!’ And the guy said, ‘Geez, Joe, I’m sorry.’ I looked up and it was Jim Cameron! I said: ‘Sorry, Jim. I thought it was some asshole stepping on my batteries.’”

Take two was near perfection, with even the water remaining in scale. “Water is always a problem with miniatures,” stated Bruno. “One of the things that worried me about the bridge explosion was the likelihood of blowing chunks of plaster up in the air that would then come down and make huge out-of-scale splashes. Jim seemed to think that if that happened we could take them out digitally, but I had my doubts. My happy realization when we saw the footage was that the primacord detonated so fast it pulverized the plaster road surface. So the first thing to hit the water was plaster dust which spread out over the surface. Then the secondary blast went off and the big chunks splashing into the water were covered by this lingering dust. So there was no scale problem. It’s as realistic an explosion on water as I’ve ever seen.”

Cameron agreed. “At one point, we considered doing the explosion full-size by spanning the gap in the Seven Mile Bridge and then actually blowing it up. In fact, Stephanie and Scott Thaler, the production manager, were sort of pushing that idea when they found out how much the miniature



Post-detonation scenes were shot live on the historic old Seven Mile Bridge which, upon deactivation a decade ago, had had a large turngate removed to allow ship passage. The art department – under production designer Peter Lamont – dressed the gap to look as though the bridge had just collapsed. Salvage from a recently dismantled bridge was arranged on two large barges which were floated into the area and then sunk so that only the apparent wreckage showed above the water.



To dispose of the truck – which had failed to land in the water during the miniature explosion – undamaged and restored sections of the bridge model were assembled in the Digital Domain parking lot where an insert shot of the truck crashing through the guardrail was planned. After weeks of weather delays and several flawed attempts, the shot was scrubbed in favor of an alternate concept.

was going to cost. They felt we could build a bridge cheaper. I said, 'Yeah, but we'd have to build it out of wood and breakaway materials that always look fake flying through the air.' We can make it look more real by doing it in miniature. And we did. The bridge explosion is perfect – 4.0 average. Everything was done right. A lot of the credit for that goes to John Bruno. He said: 'Shoot it in Florida. The sky will match, the water will match, the quality of the light will match. The real bridge will be nearby so we can use it as reference. Let's just build a big-ass model out in the water and blow it up!'”

After its final scenes on the causeway, the Pennington Harrier had been disassembled and shipped back to the Syncro Hangar in Van Nuys for greenscreen and other stage photography that would commence when the production returned to Los Angeles. The McFadden motion base was also on site. In Miami, the base had been securely bolted to the building frame since there was no anticipated need to move it around. For the scenes in the hangar, however, it was expected that the plane would have to be moved frequently, so Mark Noel began exploring various options. “On *Jurassic Park*, the base had been bolted to the floor with about forty-eight shielded concrete bolts – which made it a major job whenever it had to be moved. McFadden thought we should do the same with the Harrier. With all the torque and inertia involved when the thing got moving, they were convinced it was going to start walking all over the ground and kill everybody in the building. I kept saying: 'Isn't there any other solution? What if we need to move this thing eight or ten times?' Finally, I suggested, 'What if we take 25,000 pounds of lead and weight it down?' It took about two weeks to convince them that it would work, but eventually that's what we did. We took telescopic weight boxes that weighed about 8000 pounds apiece and slid them into sockets on the corners of the big triangular base. Under each weight box we put two air bearings – which were amazingly powerful for their size. They were only twenty inches in diameter and two inches thick, but each one could lift 7000 pounds on a cushion of air when pumped up with a compressor. Six of them were more than enough to lift the whole rig. Then we made a big tow bar for a forklift so we could push it around. In a building with a decent floor, we could have moved it anywhere on stage in about fifteen minutes; but the hangar floor was pretty uneven, so it took longer.”

An enormous greenscreen – 120 feet wide and 35 feet tall – wrapped around two sides of the Harrier. Additional greenscreen material was draped over the motion base and spread on the stage floor. “The greenscreen was huge,” commented effects director of photography Doug Smith, “but there was never quite enough of it. John Bruno had figured out in advance how to get all the angles that were storyboarded; but when Jim showed up, a lot of that changed. He wanted more camera motion and really fluid moves – and so things just tended to go off the screen. The jet would be thrashing around on hydraulics and the camera operator would be framing for the action – and rarely would anything happen exactly the same way twice. Between takes, people would be running around adding and moving greenscreens to cover the areas where we'd just gone off. And Russ Carpenter would be calling for more lights. It was constant action – everything moving very quickly.”

Although the motion base had been operated in real time during most of the rooftop shoot in Miami, the complexity of the greenscreen setups on stage – and the eventual need for the Harrier to fit into preexisting background plates – dictated that its motion control capabilities be employed. “We programmed all our moves with the waldo,” said Noel. “McFadden was surprised when I told

them that was how I wanted to do it. Usually, motion bases are programmed one axis at a time. I asked, 'Can you guys handle six inputs at once?' And they went, 'Well, sure, I guess we can.' So we took our waldo down there and they interfaced it and tested it and it worked fine. As a result, we were able to do all our programming in real time." In addition to aircraft maneuvers, the shots demanded complicated camera moves to simulate air-to-air photography. Moreover, the Harrier's hovering rotation – typically simulated with a combination of plane and camera moves – required that key lighting representing the sun be repositioned throughout. To accomplish this, Carpenter rigged high-intensity lighting units on a Chapman crane that moved in a predetermined arc around the set during specific shots.

During the greenscreen shoot, video operator Scott Warner – who provided shot playback for the director throughout the show – utilized an off-line video compositing system so that aircraft and camera moves could be previewed in rough composite with their chosen background plates. The system also proved valuable for scenes of Eliza Dushku and Art Malik on a mockup of the construction crane boom which was erected on stage over stunt bags covered with greenscreen material.

While this was underway at one end of the hangar, a section of the Interterra Building was being replicated at the opposite end for a scene in which the Harrier rises into view outside and opens fire on the terrorists within. The interior set was flanked by a wall of windows – ninety feet wide and thirty feet tall – whose full field of view was occupied by an expansive wraparound translight of downtown Miami. "The floor we built was supposed to represent two different floors," said Peter Lamont. "We had already shot one of them and were redressing for the big blow-out when the Northridge earthquake hit." Spreading death and destruction throughout greater Los Angeles, the Northridge quake – a magnitude 6.7 on the Richter scale – struck hard in the early morning hours of January 17. Its epicenter was only a mile from the Van Nuys Airport. "We went to the hangar the next day expecting the worst. Two of the big hangar doors had fallen out – which was astonishing! The little art department we had there was absolutely trashed. A water pipe – part of the sprinkler system – had broken and soaked some of the building set. But incredibly, the set itself was still standing – and not a pane of glass had broken. Our glass supplier told me that in his shop, everything that was laying east-west was destroyed and everything that was laying north-south survived. Our set happened to be north-south." Although structural damage was minimal the hangar had to be inspected and essential repairs made before production could recommence. Only three shooting days were lost to the worst earthquake to hit Los Angeles in modern history.



Crew chief Leslie Ekker and Pat McClung examine the truck model after a failed attempt to launch it through the guardrail.



As a demonstration of capability and intent the terrorists detonate one of their nuclear weapons on a small island in the Keys. Engaged to create the blast was Jamie Dixon of Pacific Data Images. After exhaustive study of nuclear test footage, Cameron and Dixon settled on a look that was created entirely with computer graphics.

When it came time for the Harrier to blow out the high-rise windows, Tommy Fisher and his pyrotechnics team spent hours rigging the interior and exterior of the set with glass breakers and explosive charges. Stunt performers playing terrorists took their positions within. On cue, the Harrier – attached by cable to a long crane arm – was hoisted into the scene and puppeteered through a move that had its blazing cannon traverse the expanse of glass in sync with the destructive swathe cut by the pyrotechnics.

Once the shot was approved, the Interterra set was quickly struck and replaced with another glass-faced structure representing a portion of the Capital Bank Building situated across the street. Inside an upper-story office, a lone janitor was to be shown vacuuming and cleaning, blissfully unaware of the warplane whirling about just outside – until it sweeps into the building, shattering windows and reducing his surroundings to rubble. Since it was John Bruno who had suggested the gag, Cameron tapped him to play the preoccupied custodian.

The Harrier had already withstood a lot of punishment. On the rooftop of the Interterra Building, its tail had impacted with the construction crane on an occasion or two. Later it had sustained a hard hit during its Miami landing when the crane operator's view was obscured by smoke and fire. But throughout, it had always held together. "That airplane took a lot of abuse," said Don Pennington, "and every time it went through something particularly strenuous, I would say, 'Well, you didn't break it, Jim.' It became a real thing with me." After hours of preparation and rehearsals, the effects team and stunt performers were ready for the Harrier's final scene. Cameras rolled and the crane swung the airplane forcefully into the face of the replicated bank building. Glass shattered explosively, furniture scattered in pieces, John Bruno scrambled for cover and stuntman Jimmy Rogers tumbled backwards off the fuselage. It was a spectacular sight; but the split-second timing of stage effects and action had been sufficiently imprecise to require another take – and Pennington's airplane had sustained its first significant damage. "I said, 'Well, Jim, it took five months, but you finally broke my airplane.' The original storyboards had shown the plane breaking the glass and doing a mild sweep through the building before pulling back out. It was plenty strong enough to do that. But Jim decided he really wanted to ram it through, all the way to the rear wall of the office. When we did the shot, the tail passed a doorway – Jim had a camera back there – and the two vertical stabilizers slammed into the wall, which was not a breakaway."

It took a week for the set to be made serviceable again, during which time Pennington and crew reassembled the Harrier and strengthened its tail section for an even greater jolt since Cameron had determined in the interim that the airplane had struck the building with insufficient force and speed. Convinced that the crane rig was inadequate to the task, Tommy Fisher and his unit bolted the original motion base mount to a steel frame fitted with large casters that rode on tracks leading up to the building facade. Steel cable extending under the set connected the rolling rig – with the



Having found each other anew, Harry and Helen barely notice the nuclear detonation behind them. Since the foreground plate of Arnold Schwarzenegger and Jamie Lee Curtis had been shot in late afternoon, there was insufficient light to hold depth of field on both the actors and the distant horizon. Since neither Cameron nor Dixon wanted the bomb to be out of focus, the actors were digitally rotoscoped from the selected take and incorporated into a clean plate – with horizon in focus – that fortuitously had been shot as a backup.

plane now attached – to a tractor truck. After another lengthy prep period, all was in readiness. Action was called and the truck lurched forward, yanking the plane into the building with predictably devastating results. Once it was determined that the stunt performers were okay, Cameron studied video playbacks from each of the five cameras covering the shot and then pronounced to cast and crew that principal photography was wrapped.

For the seven months that *True Lies* had been crisscrossing the country from one location to the next, Digital Domain had been stitching itself together and bracing for the postproduction onslaught. “Our first-year goal was to build a state-of-the-art digital production studio,” stated Scott Ross. “That meant acquiring talent and acquiring technology and building a facility – and then entering the market within the top tier. I recognized that as ambitious; but in many ways – technologically, creatively, organizationally – it proved even more difficult than I had imagined. My experience in the past had been with companies that were already running successfully when I took over. It was like being handed the Venus de Milo. There were a few parts missing and I got to work on those. But that’s nothing like having someone hand you a lump of clay, and say, ‘Now how about that Venus de Milo?’”

Although it had declared itself an entity in April, Digital Domain did not even have a home until just shortly before *True Lies* – its first major project – started shooting in August. Preliminary hardware and software trials had been underway at Stan Winston Studio, but it was not until late July that Digital Domain began its phased takeover of the former Chiat/Day ad agency building in Venice. Six months later, it would finally have sole possession of the 70,000-square-foot complex. “We knew we would need a lot of space, because in addition to mounting a digital facility we felt it was important that we also be able to provide traditional photographic effects. So we built four large stages for motion control and miniature work.”

True Lies would make more than ample use of the studio’s traditional capabilities. Although most of the Harrier shots had been attainable with the full-size mockup, no one questioned that miniatures would still be needed. Just how big they should be was a matter of conjecture. In the original script, three Harrier aircraft – not two – were to respond to Harry’s call to arms and one of them was to be shot down by a hand-held Stinger missile fired at it by the fleeing terrorists. Quarter-scale was deemed optimal for the fiery crash; but a quarter-scale Harrier would have been an unwieldy twelve feet in length. A compromise was struck at eight-and-a-half feet – slightly smaller than fifth-scale. Even though the crash was later excised from the script for budgetary reasons, the scale of the Harrier was kept unchanged so as to be consistent with other building and models which would need to explode. Hired to construct the plane was veteran aircraft modeler Larry Jolly.

As an aeronautical engineer in the aerospace industry, Jolly had for years amused himself in off hours by fabricating and flying radio-controlled model airplanes and helicopters. That work-play relationship changed, however, when national competition brought his hobbyist skills to the attention of Hollywood filmmakers. A decade later, Jolly now labors full-time at what he used to do strictly for fun. “The AV-8 Harrier is an interesting



When Harry learns that his daughter has been taken hostage by the terrorists and is being held in a high-rise office building in Miami he commandeers one of the

airplane because it's completely sculpted – like a piece of art. There are no straight lines anywhere on it. We got a lot of detailed drawings from McDonnell Douglas – they build the American version of the Harrier – and we started building a template for the plane out of high-grade plywood, filling in areas with PVC foam and making it about a sixteenth-of-an-inch undersize so we could put two or three layers of ten-ounce fiberglass cloth on it. Then we spread on bondo – a polyester putty that's excellent for precision sculpting and scribing. We also added rivets. From there we made fiberglass molds – a complicated process since we had to do the plane in about fourteen separate pieces. The final skins were made of a fiberglass laminate material that we painted into the molds.”

Harriers and heads off to her rescue. For scenes showing Arnold Schwarzenegger apparently flying the aircraft a full-scale mockup was required. Donald Pennington and crew traveled to a Marine Corps base in Arizona where they were allowed to take molds off an actual Harrier.

Back in Los Angeles, sturdy fiberglass skins were produced and fitted over a steel frame designed to come apart for transport. Although most of the plane was built from scratch, salvage items from real Harriers were used whenever available.

On location in Miami, Pennington repairs some damage after his plane was dropped on its tail during a landing scene.

Two fully assembled models were delivered to Digital Domain for final detailing and painting. “We were still without a model shop at the time,” said Pat McClung, “but we were given a small conference room to work in. A number of people were on and off the Harriers over a two- or three-week period. John Ferrari and my brother Jerry started on the first one and then got pulled away. Alan Faucher and Jon Warren finished it up and then went on to the second one. We added positionable vectoring thrust nozzles and flaps and little vents and rotatable tail assemblies – all kinds of things. Then Rachel Kelley did the paint jobs – based on Pennington’s jet – and applied the necessary graphics from photos I had taken in Florida.”

For ten shots requiring unusually complex camera or aircraft moves, one of the Harrier models was attached to a motion control pylon and photographed on stage. Electing to limit their purchase of motion control equipment, Digital Domain laid down sixty feet of precision track and rented from Sony Pictures Imageworks a rig that had originally belonged to the now defunct Apogee. Doug Smith – an Apogee partner who had logged many an hour on the unit – felt right at home with it. “It has a reflex Vistavision camera with a follow-focus base that is very precise. And since the camera is very small, it can get into fairly tight places – which is always an advantage. Plus the head design is narrow, which means you can get closer to side objects such as lighting equipment or flags.” Although several shots were accomplished with the rig, it had to be returned to Sony Imageworks before the work was completed. “We gambled and lost. We knew Sony had it booked for some of their effects sequences in *Speed*; but after asking around, we felt their production schedule would be pushed. Unfortunately, it was not; so we had to switch over to another rig that we got from The Chandler Group. It was a good unit with a Beaumont minicam that was also quite small; but having to switch out motion control equipment in the middle of production was pretty disruptive.”

Since the Harrier was being photographed for insertion into live-action backgrounds shot wild in Miami, an efficient rotoscoping and image-fitting tool was needed on stage. Motion control operator Michael Karp discovered one in the Personal Animation Recorder from Digital Processing Systems. “Not too long ago,” stated Karp, “if you wanted to know how a model move was to look composited,

you would shoot it on film, run a quick black-and-white print, and then bipack it with the background on a Moviola. Sometimes you would need to do tripacks and it would be difficult to see all the images. The move now is toward using video compositing systems on stage. A lot of them are very expensive or have limited capabilities – or both – but the Personal Animation Recorder is a versatile and affordable system that we were able to run on an Amiga 4000 in conjunction with a Panasonic MX50 video switcher.”

Once a background plate was approved, it was sent to Composite Image Systems where it was pin-registered and transferred to digital video with a grid superimposed over the image area. “With film,” Karp continued, “lining up elements is easy because of the perforations. But in video, there’s no such reference; so a grid is helpful. The digital frames from CIS were compressed and stored on our computer hard disk for on-set playback. On the motion control camera was a video assist unit that also fed into the computer. The video switcher allowed us to do dissolves and wipes and chroma keys very simply, so we could look at the scene frame by frame and just program the model by eye until we got a good fit. One of the things we had to deal with was focal length mismatch. In some cases, the plane was shot with a 28mm lens for placement into background plates that were shot with a 100mm zoom – maybe longer. Often that kind of mismatch is unacceptable; but we managed to get away with it because the plane was in the air and the perspective landmarks were not too obvious.”

One of the drawbacks of doing motion control with large models is the amount of time it takes them to cycle through moves. “The ideal, of course, is to program in real time,” observed Karp, “but with a large model, that’s virtually impossible. Even if you could get the motors to run fast enough, you might damage the model. The Harrier, for example, could only go about one-twelfth *Speed* without vibrating. So that was not the answer. I recalled being on a job a while back where a puppeteer had sensors all over his face so that when he opened his mouth, the puppet he was operating would open its mouth. I thought: ‘Why don’t we do that with the Harrier? We can’t move the model in real time because it’s too big. Let’s build a little one and move it.’ So we got a Harrier kit model that weighed about eight ounces, and we put it on a three-axis mover on a rotating motion control head. With a joystick, I was able to do moves in real time and record them. Then – once they were approved by John Bruno and Doug Smith – I could translate them up to the real model.”



To simulate the Harrier's vertical takeoff and landing capability, the mockup was suspended from a three-wire puppeteering rig attached to a large crane arm. In postproduction, the wires were removed digitally.



Among the distinctive features of the Harrier is the rippling heat signature issuing from its vertical thrusters whenever the aircraft is in hover mode. Heat signatures for the mockup – refractive effects that distorted the background imagery – were produced as 3-D computer graphics at Digital Domain. Extensive rotoscoping was required in the takeoff shots to place the effect behind actors in the foreground. Dust and paper elements were also added.



A shot of a real Harrier approaching Miami revealed its Marine pilot in flight suit and helmet.

Not only the airplane required motion control. Since many of the shots were quite tight, articulated puppets representing Harry, Dana and Aziz were needed. “I recalled seeing photos of a puppet made for T2 that was a dead-on likeness of Arnold Schwarzenegger,” stated Pat McClung. “I was really impressed, because sculpting accurate likenesses very small is extremely difficult. So I asked around and found that the puppet was built by Dan Platt, who had been at Fantasy II at the time, but now had his own company.” Approached by McClung, Platt accepted the *True Lies* assignment with enthusiasm and was provided with detailed photographs of the actors in costume. Midway into his six-week

fabrication schedule, the Northridge earthquake ripped through the San Fernando Valley and left his Sherman Oaks workshop in a shambles. “I thought, ‘Oh my God, our puppets are mush.’ I called Dan, and he said the sculptures were buried under piles of stuff. It took him a week to dig out; but the sculptures survived, and he still managed to deliver the puppets on schedule. Everybody marveled over them. They were probably the best puppets that have ever been made for this kind of application.”

“Mitch DeVane and I sculpted the figures in Chavant clay because of its excellent properties for holding extreme detail,” said Platt. “At the scale we were working, doing the faces was about equivalent to sculpting a life-size likeness with a shovel. Epoxical molds were made from the sculptures and pigmented JRG silicone was injected between the cores. The resulting skins – painted by Paula Matei – were then fitted over mechanical underskulls built by Mat Falls and fastened to the body shells. White Angora hair – much finer than human hair – was dyed to match the actors’ and then hand-punched into the tiny heads. Paula and Carolyn Sackett made the miniature clothing, painstakingly copying the full-size costumes.” For the minimal articulations required of the puppets, tiny cable-controlled mechanisms were connected to external servos driven by the motion control system.

Like its full-size counterpart, the fifth-scale Harrier was photographed greenscreen. “Shooting greenscreen is much the same as shooting bluescreen,” Smith observed. “Even the problems are the same, except instead of fighting blue reflection and blue spill you get to fight green reflection and green spill. One nice thing, though, is that your eyes don’t have the problems with green that they do with blue. With a really narrowband bluescreen, your eyes create built-in matte lines around objects.” Even though adequate mattes could be derived from a single greenscreen beauty pass, three separate passes were usually filmed to enhance the likelihood of getting elements unblemished by spill or reflections. “We would do one beauty-lit pass of the plane against a gray or black background, another beauty-lit pass with the plane against greenscreen and a final pass with the unlit plane against greenscreen. With those three passes, there was plenty of protection in the event there were matting problems.”



Boss Film Studios digitally removed the pilot and replaced him with an Arnold Schwarzenegger stunt double.

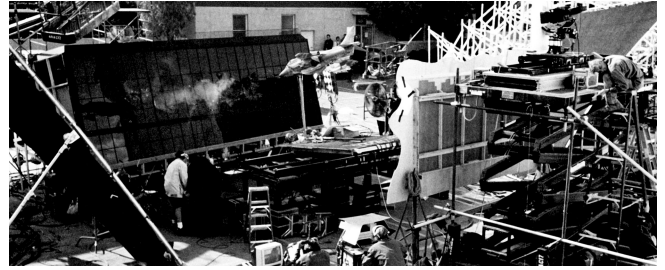


Harry pilots his plane up to the Miami high-rise and hovers outside before opening fire on the terrorists within. The scene was filmed in a second hangar at Van Nuys Airport where a live-action set was constructed overlooking a wraparound translight of the Miami business district. The Harrier mockup was suspended outside by a single cable attached to a crane.



Although much of the film was accomplished with the full-size replica, two miniature Harriers were built by Larry Jolly and detailed by the Digital Domain model crew. Pat McClung positions one for an aerial shot that was ultimately cut from the film.

While overseeing the stage work, Smith was also shuttling back and forth to the facility parking lot where another unit was doing high-speed miniature shots of exploding buildings and helicopters. In one – a reverse angle of the interior shot accomplished full-size at the Syncro Hangar – the Harrier had to open fire on the twentieth floor of the terrorists' high-rise stronghold, blasting out most of its windows. A number of related shots were also required. Then later, at the climax of the sequence, the plane needed to launch a Sidewinder missile – with Aziz dangling from it – through the blasted-out building and into a terrorist helicopter.



Part of the high-rise office building was replicated in miniature for several explosive scenes – including one in which the Harrier shoots out the entire twentieth floor. The building face – rigged with pyrotechnics – was Alted back so that broken glass would tend to fall inward. The model Harrier was mounted on a gimbal with a nailboard striker extending off its pivoting axis to insure perfect lineup between airplane and bullet hits.

Under the direction of crew chief Alan Faucher, a single face of the Interterra Building – representing the top third of the structure – had been constructed in fifth-scale beginning in late December. Since the area designated to be the Digital Domain model shop was still occupied by Chiat/Day at the time, construction had to take place in the facility parking lot. “That wouldn’t necessarily have been a problem,” said Pat McClung, “except that we were in the middle of the Southern California rainy season. A lot of the work was done out in the open; but we couldn’t count on good weather, so I bought a thirty-by-forty-foot tent that was about thirteen feet tall, and we put that up in the parking lot. Every night, Alan and his crew had to pull everything inside the tent and button it down. We did have some terrific windstorms and rainstorms, so the tent definitely paid off. Unfortunately we realized too late that we had put it at the lowest point in the parking lot. When it rained, it was like a river running through there.”

The miniature building face – thirteen feet tall and twenty-four feet wide – was framed in wood and surfaced to resemble its full-size counterpart in Miami. Since the twentieth floor was to be razed by Harrier cannon fire, a suitable breakaway material had to be found to simulate high-rise window glass. “Movie glass almost never works with miniatures,” asserted McClung. “Usually it’s some kind of styrene plastic; and when it shatters, the shards are huge and completely out of scale. In the past, I’ve had success using very, very thin glass – ten or twenty thousandths of an inch thick – but it only comes in about foot-square sections and these windows needed to be much larger than that. I recalled visiting Bob Skotak one time when he was blowing up a building for Darkman – and he was using tempered glass. Because tempered glass is heat treated and then cooled, when it shatters it breaks into very small pieces, usually no bigger than an eighth of an inch across. We tested other materials, but nothing worked as well.”

A problem still remained, however. The windows on the real building were tinted black from the outside. “For everything to match,” related Faucher, “we wanted tinted windows for the miniature. But when you tint tempered glass, the tinting bonds it so that it no longer shatters. After a lot of testing, we came to realize that the only way to do it was to paint the back side of the glass. That required further tests because many lacquer paints would either hinder the break or not stick to glass. Finally we found one that worked – a flat black lacquer in spray cans – but it was very thin, so we had to apply several coats.” The lower-floor windows – which would not be required to shatter –

were less problematic. “We used opaque black plexiglass. The only problem there was that plex is notorious for warping. To keep it from doing that in the hot sun, we kept all the plex surfaces covered – either with white nylon tent panels or sheets of foamcore – until just before each take.”

For the main blowout scene, the upper portion of the structure was erected at a slight backward angle so that the shattered glass would tend to fall into the building rather than burst outward. “We had lead mullions between the glass panels,” said Faucher, “and we ran wires from them to weights so that as they were shot out, the mullions would just collapse and pull the glass back into the building. Inside we put a drop ceiling that was also rigged to collapse and some loose furniture and barrels that would fly around. And since the windows had to break in a predetermined pattern, we made a wooden cutout and glued it to the back side of the glass so the areas that weren’t supposed to blow away would remain intact.”

Although the shot could be achieved most simply as a composite, with the Harrier matted in later, John Bruno felt strongly that the airplane needed to be in the scene for maximum interactivity. “Leslie Ekker was hired to build a gimbal mount so the jet could rock and roll on some sort of knuckle attached to the fuselage,” said McClung. “The pole supporting it would be removed digitally later on. Les did an excellent job. He used high-quality roller blade wheels for the rotating aspect and attached two arms at the base to control pitch and roll. One person could operate everything.” Since the building was slanted back, the Harrier had to be positioned slightly above it, tilted down. The camera, further back, was higher still. “The camera was facing into this glass building; and what it should have been seeing in reflection was the skyline of Miami. What it was seeing were some buildings across the street from our parking lot. So Ron Gress came in with his partner, Suzy Misceovich, and the two of them painted a backing of a Miami-type sky to put behind the camera. It was sixty feet wide and thirty feet tall, and they did it in one day! Then, to conceal the camera itself and the rigging around it, we built a cloud flat that we attached to scaffolding in front of the camera. The only thing showing was a little square cutout for the camera matte box, which we knew could be removed from the reflection digitally.”

Joe Viskocil and Emmet Kane orchestrated the pyrotechnics. “There were twenty panes of glass that needed to blow out,” said Viskocil, “so we put window busters on each one. Window busters are like explosive bolts on aircraft. Each has a charge inside that drives a small pin into the glass. With tempered glass, you can hit it anywhere and the whole pane spider-webs. We also had four hundred bullet hits – flat body-type hits that we taped to the inside of the windows and sprayed black. Each had its own lead that we wired to a semicircular nailboard – four hits per nail. The tricky part for us was making sure that each charge fired at exactly the moment the Harrier lined up on it. Emmet made it easy by building a striker that came off the pivoting axis of the plane and swept across the nailboard. No matter how fast or slow the operator went, the right nail would always be hit at the right time.”



Having snatched the key needed to arm the nuclear bomb that Crimson Jihad is threatening to detonate in Miami Dana Tasker (Eliza Dushku) flees to the roof of the building with Aziz in hot pursuit Both climb out onto a construction crane, where Dana slips and nearly falls as her father maneuvers his plane into position to save her.



Much of the sequence was shot on a high-rise rooftop in Miami with the Harrier mockup on a multi-axial motion base that produced a remarkable simulation of hovering flight.

Once the pyro rigging was complete – a five-hour task – Pat McClung manned the gimbal controls and puppeteered the Harrier through the shot. Everything went much as planned, but the results were less than spectacular. “It just didn’t have much punch,” Viskocil admitted. “After that first take, we started adding flashbulbs. Flashbulbs are a great way to make something look like an explosion when it really isn’t. We used a couple dozen of the old AG1 Instamatic flashbulbs – which I’ve hoarded since they aren’t being made anymore – and dipped them in orange gel. We tied those in with the bullet hits and they really helped sell the shot. Still, Jim wanted the effect bigger and bigger, and he started talking about primacord. I knew that primacord would change the look of the shot, because inevitably it would blow the glass out toward the plane rather than into the building – but that was okay, I guess, because that’s what happened when they did it full-size on stage. We ended up doing four takes – each bigger than the last – before we finally got the one Jim was looking for.”



By framing out the base, a large number of shots could be achieved in a setting that was precisely what it was supposed to be – high over downtown Miami – with Arnold Schwarzenegger clearly at the controls.

Although streams of flame should have belched from the Harrier’s cannon as it fired, rigging such an effect for the live model shot was deemed unnecessarily problematic. “We did have some interactive lighting on the plane,” noted McClung. “Victor Abbene, our gaffer, directed a large HMI light through a wagon-wheel device the guys whipped up to produce a flickering effect. That was reflected by a mirror onto the plane near the gun pod.” Later, on a darkened stage, Doug Smith photographed bursts of propane flame which were then composited digitally into the scene.

Tor a subsequent shot, the full structure – now representing an adjacent face of the building – was erected on an eighteen-foot-tall scaffold anchored securely into the asphalt. Off the side and slightly to the rear, the Harrier was suspended by wires from a crane. As storyboarded, cannon fire from the hovering aircraft was to rip through the entire floor and blow out windows on the camera side of the building. “The model was put up in the air so we could get enough camera clearance to avoid some of the local buildings nearby,” commented Faucher. “It wasn’t quite enough, however, so the decision was made to tilt the model forward ten degrees to get clear sky behind it. That turned out to be pretty scary. Not only did we have a three-thousand-pound model sitting in an unstable position eighteen feet in the air, but on top of it – leaning out – we had a six-hundred-pound crane model that Jerry McClung had welded together from steel.” For safety, Viskocil and Kane rigged their pyrotechnics before the building face was tilted forward and tied off with cables. The first take showed promise; but before a second could be attempted, notice arrived that the shot was no longer needed.

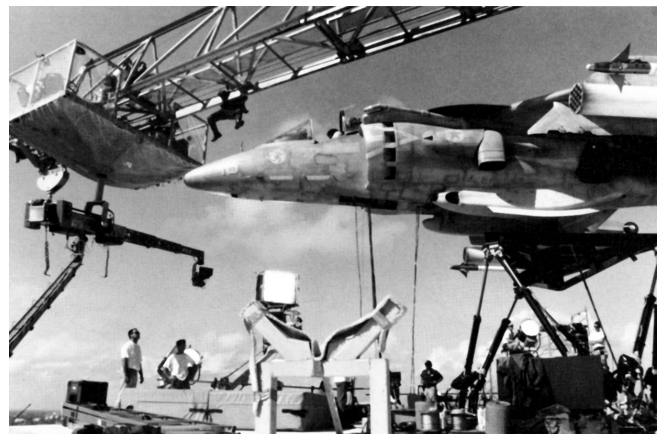
Next on the list of major shots was the terrorist helicopter being blown up by the Sidewinder missile that Harry launches through the gutted building. The missile and its trail would be computer generated, but the explosion was to be a live miniature effect. Copying the helicopter used during principal photography, Larry Jolly and his crew built three fifth-scale AS-350 A-Stars.

“Unlike the Harriers,” stated Jolly, “the A-Stars we delivered were fully detailed and painted. The shells were epoxy resin – which I like to use because it can take a lot of abuse – and they weighed less than three pounds apiece out of the mold.” Though Jolly’s specialty is model helicopters that fly, the doomed A-Stars needed only to be hung from wires. “We’ve built radio-controlled helicopters that were blown up in flight; but Joe Viskocil won’t do that. He feels it’s safer to hard-wire his explosions. That being the case, all I needed to do was design a heavy-duty gear train to turn the rotors.”

Two mobile cranes were erected near the elevated building, with a stout cable connecting them. A vertical cable midspan supported the helicopter. On the pavement directly below – encased in a plywood housing with a clear acrylic top – a camera faced straight up. A dozen yards away, a second camera – also shielded – was on a shooting platform level with the model. When all preparations were complete, Viskocil and Kane boarded a scissor-lift to load the pyro. “The helicopter had to blow apart in a very specific way,” noted Viskocil, “because it had to match wreckage that had already been shot full-size. The model was prescored to help make that happen. We planned a two-banger – a nice big fireball to start and then a blast to obliterate the model. The fireball was a gasoline explosion. We put gas mortars in each doorway – directing most of the blast out the side opposite where the missile was going to hit. I like Tupperware containers for gas mortars because they’re lightweight but can still contain an explosion. The really big blast was from primacord which we laid into the shell of the ship. The last thing we did was pile in lots of loose debris.”

From a safe vantage point on the ground, Viskocil was to detonate the two-part explosion manually, first triggering the gas bombs and then following a split-second later with the primacord. Simultaneously, a trip wire would release the helicopter which would fall directly onto the camera emplacement. The shot was plagued with problems. On take one, the gas bombs detonated, but the primacord did not. “It was important to let the fireball fully ignite,” said Viskocil, “otherwise, the primacord would snuff it out. On our initial take, however, the gas bombs severed the wire leads to the primacord, preventing it from going off.” A second attempt, several days later, was technically successful, but Cameron thought the blast should be bigger. Pyro charges were increased – supplemented with rubber cement to sustain the burn – but the third attempt was a replay of the first. Finally, after a rush order for more helicopters, the scene was successfully captured on take six. “It was an enormous blast – probably twice the size of our first one. The only problem was that a glob of unignited rubber cement landed right on the acrylic covering the camera lens. Rather than do the shot over – again – it was given to the digital guys and they managed to get rid of it.”

One of the last big model shots took place on stage. “We needed to show Aziz being fired through the building,” stated Mike Chambers. “Jimmy Roberts came in – doubling for Art Malik – and we filmed him hanging off the missile against greenscreen. For the background, we needed a miniature of the building interior thoroughly trashed after being shot up by the Harrier. Alan Faucher and his crew built a platform about eight feet off the floor and put the building face that had been outside on one end of it.



The rest of it they covered with a miniature drop ceiling and dressed with broken tables and chairs and lots of debris. The building was supposed to be under construction, so the detailing was fairly simple.” The camera was to pass through the expanse of broken windows and traverse the interior towards another gaping hole on the opposite side of the building. “The outside windows were very reflective, so on the approach we had to disguise the camera rig and place a section of Miami translight behind it. We also cheated the size. If the interior had been built to scale, the pass-through would have been so short that what was happening would barely have registered. So the set was built about twice as long as it should have been.”

Since the confined rooftop offered limited options for camera placement the production commissioned Technocrane to build an enclosed platform that could travel up and down the full length of the construction crane boom which was both a set piece for the film and an essential working tool. The Technocrane – a telescoping camera mount that can duplicate track moves and traveling crane shots from a fixed position – was attached to a post extending from the bottom of the platform. By combining construction crane moves and Technocrane moves, the camera could be positioned at virtually any point in space within a three-hundred-foot radius.

The Harrier mockup bobs and weaves on its motion base as terrorists circle in an A-Star helicopter firing machine guns at it.

“Our original intent was to mount the camera on a pole arm,” said Doug Smith, “but when the model size increased – to about forty feet in length – that became impractical. So we cut a slot in the floor and covered it with rubber flaps and lightweight debris. The motion control rig was on rails underneath, and the camera was attached to a steel blade that extended up through the slot and into the set. As the camera traveled through the front of the building, we had to pull the window pieces away to allow for clearance. After that, the floor flaps just peeled back as the blade sliced through.” At the far end of the set – visible through the onrushing expanse of broken windows – was a greenscreen. Live-action footage of the terrorist helicopter hovering over Miami would eventually replace it. “It took us only two takes to get the shot, but each take required about seven passes because of multiple light sources.”

In a building across from the stages was the digital part of Digital Domain where computer artists spent their days manipulating images on high-tech workstation monitors. “To get an edge in this business,” stated Scott Ross, “we knew we would have to build a network that would allow us to process information faster than anyone else. In a matter of months, we acquired fifty-five Silicon Graphics Indigo II workstations, all connected via an FDDI fiber optic network to a central server area where all the images reside. Add our Macintosh Quadras and our IBM RS-6000s and the number goes up another twenty or so. Our central server area has eight Challenge XL machines, six multiprocessor Onyx machines and an IBM Power Visualization System. Additionally, we have network disk storage as well as workstation disk storage. The central server network has a HIPPI protocol – the fastest bandwidth protocol right now, used mainly in government and scientific supercomputers – which theoretically allows a hundred megabytes per second of data transfer.”

At peak operation, thirty-some digital artists would be dedicated expressly to *True Lies*. Signed on in October was digital effects supervisor Jacques Stroweis. “Digital Domain was a startup company,” said Stroweis, “and I was very well aware of the problems related to that because I had just come from *Last Action Hero* and RGA/LA where the situation was much the same. Building a company from scratch is very difficult – especially when you’re trying to do a major film at the same time. In this case, the film was for Jim Cameron, who was not only a partner in the company, but someone

with a reputation for being a maniac about quality. We spent a lot of time at the beginning testing equipment and software and developing procedures to insure the best possible image on film. There was new equipment coming in every week – and new people.”

At the close of principal photography, Cameron had precisely one shot of a real Harrier flying toward the Miami skyline. The remainder of his action-packed finale – and the effectiveness of it – depended largely on the ability of his digital postproduction team to make raw footage of a full-size mockup and two miniatures, shot under widely varying conditions, look and act like a real warplane hovering in combat over a major population center. Working against that objective was the fact that even real Harriers had a look of artificiality about them. “On our trip to Yuma, I took a lot of video,” said John Bruno, “and the Harrier hovering looks totally fake. You just don’t expect a jet to be able to act like a helicopter. They look like they’re suspended on wires. Our first reaction was: ‘Fake! We can do fake.’ But, in fact, that was one of the toughest things to overcome.”

Among the essential elements that needed to be added to almost every shot was the Harrier’s characteristic heat signature – a rippling column of hot air on which the aircraft appears to float in its gravity defiant hover mode. “The Harrier has four vector nozzles on its underside,” Bruno continued, “two in the front and two in the rear: but only the rear ones create a heat ripple. The front ones vent cool air. Then there’s an occasional burst of what looks like soot or black smoke. That’s from water injection. On takeoff they inject water into the thrusters to make the air more dense and give them about a twenty percent power boost. So that was something else we needed to add.” Also required was wire removal – lots of it – for not only was the mockup suspended by cables in many shots, but there were also cables tethering stunt performers and actors to the plane to prevent serious falls and injury.

Finally there was the matter of compositing greenscreen stage elements – both full-size and miniature – into appropriate background plates. For the integrity of the sequence to remain intact, footage of the full-size Harrier in Miami had to cut seamlessly with greenscreen composites of the same Harrier shot at the Syncro Hangar. Moreover, both had to intercut with model Harrier footage shot high-speed on miniature sets or motion control on a greenscreen stage. Rather than establish departments to do different types of tasks, Digital Domain opted for a diversified team concept. There was a team whose principal assignment was the missile trails, and another whose concern was the Harrier heat signatures. A third attended to those shots requiring greenscreen compositing. Within each team, there were no categorical specialties – all bore the generic title of digital artist. “We had people who were very knowledgeable about 3-D computer graphics,” said Stroweis, “and we had others who were more 2-D oriented. Still others were expert in rotoscoping or compositing. But rather than pigeonhole people in specific areas, we wanted everyone to be able to do everything. That way, we could keep our efficiency at a maximum and try to level the work. If there was bottleneck in one area, we could float some of the overflow to another.”

“Because we were busy building out the studio, developing software and bringing everything up to *Speed* early on,” said Ross, “we decided to look outside the company for our high-resolution scanning and recording needs. We did a lot of blindfold tests and tons of research, and decided that Cinesite was the top dog in terms of quality. Their Cineon system is laser-based rather than CRT-based – which is what everyone else uses – and the results, in my mind, are clearly superior. With broad daylight shots, in particular, a CRT device will often produce bloom around the dot which

imparts a kind of softness to the image. Since most of our *True Lies* shots were in bright sunlight, this was obviously a consideration.”

Although in-house software was employed extensively to composite heat signatures and missile trails, Digital Domain purchased five Discreet Logic Flame systems for greenscreen matte extraction and compositing. “Flame is actually a collection of different image processing tools,” commented digital postproduction supervisor Price Pethel. “In the past, computer graphics companies like ILM and Rhythm & Hues and PDI have custom written their own software for specific needs. Flame puts everything in one big toolbox. It’s like a Harry in the sense that it allows you to manipulate elements in a composite very interactively and very quickly. It’s like a Quantel Paintbox in the sense that it’s a painting tool. And it’s like an Avid in the sense that it can randomly access lots of frames and allow you to do cutting and pasting and basic kinds of editorial things. It also has a sophisticated color correction device and a digital effects picture mover that allows you to do optical printer and motion control type moves.”

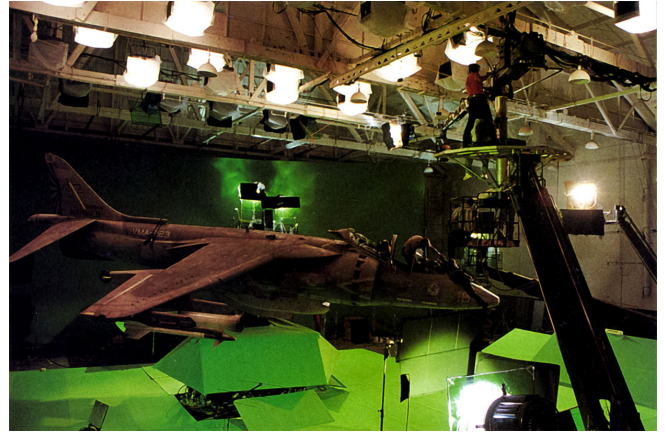
Because of its near real-time capability, Flame was an ideal mechanism for providing John Bruno and Jim Cameron with timely feedback on how specific background and foreground elements were going to fit together. “As a company,” noted Pethel, “one of the things we wanted to do was really focus on the needs of the director. What the director needs in terms of effects is to see a lot of things put together, very quickly, so he can make decisions about them. At the same time, he wants to keep his options open as long as possible so he can make changes. Allowing him those options is nerve-wracking for the effects people, but empowering for the director.”



A practical propane gun was incorporated into the mockup to simulate rapid-fire cannon bursts from the Harrier.

Using video postproduction as a paradigm for *Speed* and interactivity, Digital Domain established a three-tiered approach to effects compositing. Upon delivery, approved film elements – most of them Vistavision – were transferred to video and assembled quickly and inexpensively on an off-line video effects editing system. At that stage, element alignment and motion could be established with some degree of accuracy. Then, using Cineon film scans on Silicon Graphics machines running Flame, element alignment and motion were refined and other issues such as matting and color were addressed. The objective at this stage was to build a video-resolution composite that could be output to tape for projection in dailies. First, however, it was run through a software program that enabled the digital images to be enlarged to movie-screen size without video artifacts and scan lines. Once approved at that level, the shot went to one of the facility's film recorders – a Celco Extreme FX8 – where it was output onto film, still at video resolution, for final scrutiny before being returned to Cinesite for high-resolution film output.

With a large number of shots being worked on simultaneously at some two dozen dedicated workstations, managing the data and determining its status was an ongoing and ponderous undertaking. "The usual procedure," related assistant digital effects supervisor Gray Marshall, "was that when a scan came in from Cinesite, we would bring it into our system and apply any repositioning instructions we might have. Sometimes in shooting these big action scenes, important things would slip outside the wide-screen frameline; but with Vistavision plates, we could reposition or resize the image and bring those things back in. That was usually my job. Then our color timer would match the shot to workprint. At that point, it would be ready for rotoscoping or wire removal or compositing. This work was done by separate teams – often concurrently – so there could be two or three copies of any given shot kicking around. It got to the point where there were so many shots, and so many people making local copies of them, that who had what was becoming a big question mark. So my biggest contribution to the project – I think – was creating a program that basically walked the entire range of machines each night and compiled a database of where everything was."



In addition to rooftop work in Miami the mockup and motion base were used on an enormous greenscreen stage established at the Van Nuys hangar. Down-angles that would have shown the roof had they been shot in Miami could be filmed on the greenscreen stage and matted into background plates shot from helicopters or the construction crane.



As the Harrier pulls away with Dana clinging perilously to the nose, Aziz leaps off the crane boom and lands on the wing. The rotating background was photographed from the construction crane in Miami. The Harrier was a greenscreen stage element while Aziz was a separate element of Jimmy Roberts jumping off a mockup crane section onto a pad covered with greenscreen material.

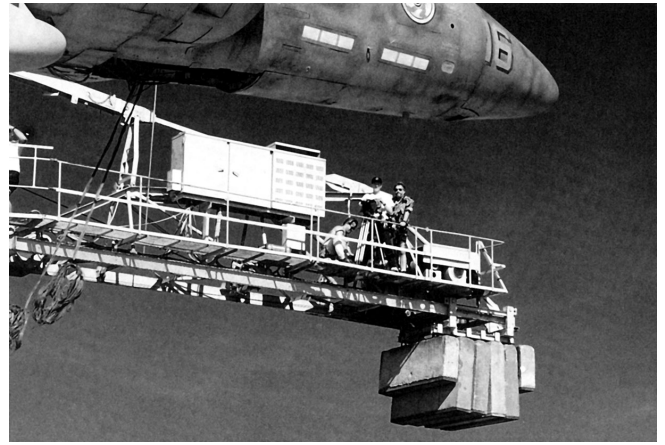
As the work progressed, requirements for data storage increased. “The original intent was to have somewhere between twelve and fifteen shots working at a time,” Marshall continued. “That quickly proved inadequate. There were simply too many shots in different stages of completion – not to mention changes coming down and decisions to add other elements. Near the end, we had approximately fifty shots on line.” To meet the demand for data storage, banks of disk units – most with 7.2 gigabyte capacity, enough to store roughly six hundred frames at full resolution – were co-opted by the production. “At our peak, we were utilizing more than three hundred gigabytes scattered throughout our network.”

Although the video compositing system used on set had allowed Cameron to choreograph his greenscreen Harrier moves in a manner appropriate to the previously shot background plates, making the fit precise – or nearly so – was relegated to postproduction. “The background plates were shot literally from helicopters flying around buildings in Miami,” related Pethel, “so there was a lot of lifting and buffeting and bumping. Jim loves that stuff. He wanted that shake and the sense of jeopardy you get from the horizon bending and twisting. That kind of thing is almost impossible to duplicate on stage, however; so it was our task to put the non-motion controlled greenscreen photography into this shaky environment and then make it look like it truly belonged there. We had one shot, for example, where we’re looking straight down on the plane. Aziz is hanging on, and below him you can see past the buildings to the street. Even if we had tried to pin-block the shot, it would not have worked because Jim had changed the sync of the background plate and wanted it to run backwards rather than forward – which was not uncommon. With the software we developed, we were able to extract motion information from the background plate and put that onto the foreground airplane. So the airplane was now shaking like the background plate. Then there was a piece of choreography on the plane that Jim liked, so we stole that motion information and imparted it to the background plate. Now the background plate was getting some of its motion characteristics from the foreground, and the foreground plate was getting some of its shake and rattle characteristics from the background. We could never have done that before. What cinched it was that we were able to take an already shot 2-D plate and give it motion blur that matched the background and was different from what it had originally because it was following a different path. That really locked everything together. It was a compositing dream.”

Elsewhere in the facility, the aesthetics of heat were being addressed. “It took a long time to develop the right look for the heat signatures and the exhaust,” remarked Stroweis. “On the one hand, we had reference footage of actual Harriers that we were trying to match; and on the other, we had Jim Cameron telling us not to be so conservative, that it was okay to exaggerate a bit. The idea was to make the audience ‘feel’ the heat, without drawing attention away from the action. In the beginning, our attempts were never quite on. The heat signature was always too dirty or too mathematical or too something else. One day, while studying for hours the footage John Bruno had given me, I realized that the Harrier heat discharge was creating a rich multi-diffraction pattern, not a simple warping of the background. To that point, we had done only one warp pass at a time. I tried stacking three warp passes with different coefficients and parameters, and saw immediately that that was the right approach. The heat signature evolved from there, but that was the breakthrough.”

Supervising animator David Isyomin was the team leader in charge of heat signatures. “Since the Harrier was moving in every shot, the first thing we had to do was track it,” Isyomin said. “We had proprietary software that allowed us to figure out the position of the camera and the focal length of the lens based just on measurements of the plane. And it was quite fast. The final shot of the Harrier landing was about seven hundred frames, and I was able to do the tracking on it in only five or six hours. Once the plane was tracked, we could tell exactly where to place the heat cones and the soot cones – which were the two components of the effect. Even though the heat signature was essentially a 2-D effect – because it was just affecting the background – we had to work in 3-D because somehow your eye would detect it if the perspective was off or the position of the heat elements was wrong. The heat signature is actually a refraction effect – hot air from the thrusters has a different refractive coefficient than the cooler air around it, and the result is like looking through millions of tiny lenses moving about randomly. Normally the background is displaced and out of focus, so we had to create elements to simulate that distortion. For the soot effect, I wrote a shader that simulated smoke coming out of the jet at about a thousand miles an hour. Everything had to be totally photorealistic.”

Heat effects varied somewhat depending upon the specifics of the shot. “We knew where the heat signature needed to be based on our 3-D tracking,” noted Isyomin, “and we could put wire-frame heat cones over the background to show the director which areas were supposed to be covered. But there were always artistic considerations. In some shots the cones are wide and in others they are narrow. Some heat was lighter or darker than others. Some had a watery look. In a few scenes, the plane moves away and we added kind of a heat trail. In others, we had heat bouncing off the ground when the plane’s hovering very close. So there were different looks.” Digital rotoscoping would also play an important role. When the Harrier lifts off from the causeway, for example, extensive roto work was required to isolate people and vehicles in the foreground so that the heat distortion effect would appear spatially correct behind them.



Perched on the construction crane some two hundred feet above the street effects cinematographer Doug Smith and John Bruno prepare to shoot plates that will serve as backgrounds for greenscreen elements of the full-size mockup and its miniature counterpart.



Since many of the motion control model shots were virtual closeups, articulated puppets representing Harry, Dana and Aziz were deemed necessary. Hired because of his reputation for sculpting remarkable likenesses in very small scale was Dan Platt of Sideshow Productions. Working from photographs, Platt and crew created intricately detailed figures whose tiny cable-controlled mechanisms connected to servos driven by the motion control system.

Among the most challenging of the shots was another of the ones Cameron and Bruno had designed to support the illusion that Arnold Schwarzenegger was indeed piloting the Harrier. At the Syncro Hangar, a greenscreen closeup had been shot of the actor 'flying' the Pennington mockup as it banked steeply away from camera. Later, on the motion control stage at Digital Domain, the live-action was rotoscoped by Michael Karp and the move continued off into the distance using the fifth-scale Harrier and puppet Harry. "The full-size jet and the model were not a perfect match – although they were close," said Isyomin. "So we did a morph between the two. We got the move on the plane to match the displacement of details, and your eye basically buys it as a changing of perspective. The funny thing is that no one really thought this would work, so the shot was designed such that the heat signature would mask the transition as the plane banked. 'Let's just cover the whole plate with heat distortion so nobody will notice.' But it turned out so well, everyone felt differently about it. 'Well, why should we cover it with heat?' So one of the last things we did on the film was go in and lessen the heat distortion. Now the effect is driven from an artistic point of view, not just a technical point of view."

Flawless wire removal was another essential for the end sequence. Nearly every shot had cables suspending the airplane or safety lines attached to stunt performers. All had to be digitally erased. Although wire removal packages were available from a number of sources, software developers at Digital Domain found them lacking and decided to create their own. "Many of the programs were difficult to use," explained Ross. "Some did not allow us to key-frame as well as we wanted and others did not allow us to bend wires. But the key issue was grain structure. Normally when you remove wires, you have to put film grain back in the area where pixels have been cloned. Our tests showed that this was a real hit-or-miss proposition. There was no organized way to find out what the grain structure was, because it would change based not only on the film stock used, but also on the camera and the light and even the cinematographer. So our software team built a grain snoop device that allowed us to determine the grain structure from adjoining pixels. Then, with literally no interface whatsoever, it just plugged that in."

By February, even though plates had been available for months, Digital Domain was still wrestling with software issues and was on the catch-up side of the learning curve. Nothing but tests had yet been produced. Moreover, the effects workload – estimated originally at sixty shots – was now creeping past one hundred. The decision was made to offload some of the work. Digital Domain would retain the showcase bridge explosion and Harrier sequences where most of the *True Lies* effects were clustered; but since their in-house wire removal software was still being debugged, several dozen of the Harrier shots were sent out to Pacific Title Digital, Computer Film Company and Cinesite for wire removal only.

A number of shots required erasure of the motion base, as well – a much more complex task. "The plan had always been to frame around the motion base," noted Bruno. "But when we were shooting in Miami, a situation came up where there was a shot of the Harrier rising. Jim had it framed tight to lose the base; but we were looking at the monitors and another camera was wide on it, and he said, 'Boy, it would be great if we could just get that base out of there.' So I said: 'Let's try it. We'll call it an alternate and see what we can do.' So we shot the scene and then – for a background plate – we moved the camera to the far side of the plane and tried to duplicate the move without the jet. Obviously, it wasn't going to be perfect, but it might be close enough for the digital guys to clone a

background. The heat signature would be under the plane anyway, and hopefully that would hide any flaws. Later we did a second shot the same way, with Aziz hanging off the missile on the wingtip.”

The first shot went to Pacific Title Digital where a successful motion base removal test was indeed effected. The realization that it could be done opened up new editorial options when it came time to cut the sequence. “Jim and I discussed it,” Bruno recalled, “and I told him: ‘Why don’t you just forget about all the cables and rigging and cut the movie you want. If the base is in, we’ll take it out. If it costs too much, we can reconsider later.’” Cameron responded by delivering a final cut that had some forty-five additional shots – eight of which required motion base removal. By this time, Digital Domain’s wire removal software was on line and the shots were handled in-house.

Once all the elements were locked together – with wires removed and heat signature added – a final step still remained. “Jim Cameron called it the ‘wugga’ effect,” said Stroweis. “A lot of the plate photography was really quite smooth – the Technocrane footage especially – and Jim wanted the sequence to look like it was shot from another plane or helicopter. He liked that kind of energy. So we had to go in and add a little digital bounce and motion blur to give it almost a hand-held kind of look.” Further nontraditional uses of digital postproduction techniques included color correcting some of the Miami skies to maintain uniformity within the sequence. “We also had to fix some of the translight shots that were done on stage. The translights were enormous and were done in panels – which is normal – but for some reason the connecting seams were quite visible in some of the shots. We used our wire removal software to eliminate them. The translights also had an overall magenta cast that we were able to correct.”

Two one-of-a-kind shots – both involving aerial footage of the real Harriers – went out to other effects companies. One that served the editorial design had the two warplanes flying in close formation – but creeping into the frame was a Lear jet being used by the production as an alternate camera platform. Cinesite salvaged the shot by digitally extracting the unwanted chase plane. Another problem shot was a dramatic aerial view of the Harrier approaching Miami in which the Marine pilot – wearing regulation flight suit and helmet – was clearly visible at the controls. Since Harry Tasker was supposed to be flying the plane in shirtsleeves and without a helmet, the shot was delivered to Boss Film Studios for digital alteration. “The shot was taken from a helicopter,” said Boss visual effects supervisor Neil Krepela, “with the helicopter flying flat out and the Harrier going the slowest it could. Even so, the plane overtook the helicopter so quickly that the camera had trouble tracking it. So the first thing we had to do was stabilize the pan a bit. The second was to photograph Arnold’s stunt double, Dieter Rauter, against bluescreen and have him mimic the turn that would be needed for the pilot. I set up a moving key light so that as he turned, the illumination would change from backlit to frontlit as the plane comes out of the sun and heads into Miami. We did about twenty takes with different timings and different looks, and found one that worked. Next we rotoscoped the cockpit, painted out the pilot and replaced the background behind him. At that point, we tracked the Arnold element into the cockpit – which entailed not only sizing, but slight timing and tracking changes to make sure he fit precisely into the fuselage. The final step was to replace the canopy by color-softening the image and reducing the contrast.”



After its scenes on the rooftop were completed, the Harrier mockup was lifted off the motion base and lowered to the street where stunt doubles were safety-tethered to it. Then it was raised again and rotated – some two hundred feet in the air – while the doubles engaged in hand-to-hand combat which Cameron photographed from a circling helicopter.

One of the first shots to arrive at Digital Domain – and one of the last to leave – was the Harrier's landing on Brickell Avenue. "We developed several different classes of heat effects for the film," said Stroweis, "and this one shot – which was seven hundred frames long – used almost all of them. First there was hovering heat, then there was the landing, and finally there was idling heat as the Harrier taxied on the street." Other elements were added also. During the live-action shoot in Miami, street litter had been blown about with fans as the plane descended onto the pavement. To augment the effect, Doug Smith photographed additional blowing debris on a darkened stage. John Bruno selected appropriate elements and directed their placement within the shot – one piece of paper is sucked into an engine – and the elements were then composited digitally into the scene. Dust and soot were likewise incorporated. As the shot came further together, Cameron felt the need to see turbines in the engine nacelles – not an issue in the aerial scenes since the turbines would have been spinning too fast to be observable anyhow. "Jim wanted a 'wagon wheel' effect as the turbines slowed. We thought about doing it as a 3-D computer graphic, but then discovered that we had footage of a real Harrier we could use. We went into that footage, lifted the turbines, mapped them in 3-D space and tracked them to the plane." The final touch was to add a digital push-in on the full-frame Vistavision image that enabled the shot to end on Schwarzenegger and Dushku in closeup.

While aerial combat over Miami was staged solely with replica Harriers – full-size and miniature – real Harriers had been used for the bridge assault. Live armament had been out of the question, obviously, so about a dozen shots in the sequence were embellished with computer generated missiles and exhaust trails. As the Harriers approach the terrorist convoy, a Stinger missile is fired from the rear of one truck. Its heat sensors lock onto one of the advancing jets, but the pilot avoids disaster with a prompt evasive maneuver. The Harriers respond in kind by launching four Maverick missiles.

Creating the missiles was a minor challenge since they were very small in the frame and traveling very fast. Providing convincing exhaust trails was quite another matter. Assigned to head the missile team was supervising animator Peter Farson who had worked on similar effects for *Flight of*



In postproduction, the single cable supporting the plane was removed and heat signatures were added.



Shots requiring unusually complex camera or aircraft moves were photographed motion control using one of the miniature Harriers. Digital Domain motion control operator Michael Karp studies a monitor display of a live-action greenscreen shot which he is rotoscoping in order to produce a matched move on the airplane model. A video compositing system on stage facilitated fitting the model photography into its designated background.

the Intruder at Rhythm & Hues. “We began by loading the background plates into Prisms,” related Farson, “which was the primary software we used for modeling and animating, although I made quite a few modifications to it. Then we rotoscoped certain features of the scene to track the airplanes or the bridge, depending on the shot. That allowed us to animate 3-D wire-frames of the missiles and smoke trails that matched whatever was happening in the background. First we animated the missile being launched from the plane or just traveling through the shot. Then, using that animation, we physically modeled our smoke exhaust being expelled out of the back of the missile. One of the elements of the program is a particle system which simulates natural forces such as wind and gravity. With that we were able to model the smoke as if it were made out of small puffs. Everything was variable, so we could alter the size of the puffs or slow them down by turning up the atmospheric drag. In wire-frame, the puffs were idealized spheres – a thousand or so, depending on the shot – but in the rendering and shading process they were interpreted as nebulous smoke that tumbled and dissipated behind the missile. We also had glow elements from the rocket engines that added quite a lot.”

A crucial aspect of the shots was matching the computer generated Mavericks to the real ones in terms of lighting and color – and making a plausible substitution in midshot. At the moment of launch, the real missiles – slung from the Harrier wings – were digitally erased and replaced with computer generated facsimiles that leapt toward the target.

Computer generated Mavericks were also incorporated into footage of the Seven Mile Bridge exploding in miniature. “We used the same basic approach on both the missiles and smoke trails,” noted Farson, “but with an extra feature. When the missiles impacted with the bridge, we wanted the smoke trails to react to the explosion in a way that seemed realistic – they couldn’t just hang there. In our particle system model, there was a kind of blast wave that traveled out at high velocity and then dissipated. We used that to create an evolution of our smoke particles so that when the explosions went off on the plate, the missile trails looked like they were being blown away by the blast. That really helped cover up any signs that we were adding computer graphics elements to these practical shots.”

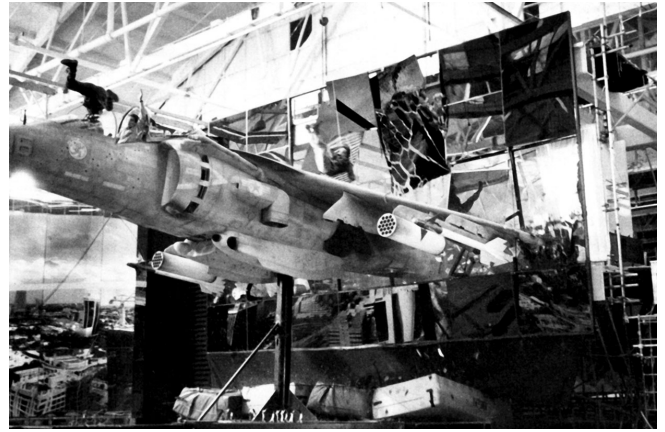
For one shot in the sequence, repositioning of the frame made it necessary to extend the bridge slightly. Digital artists did so routinely by cloning a section of the bridge from elsewhere in the shot, then resizing and repositioning it where required. The problem was that the explosion and debris needed to pass in front of the now pristine extension. “That would have been an optical *Nightmare*,” said Pethel. “One of the beauties of the Flame system is that it allows you to make difference mattes. In other words, we can take two frames from a shot and the system will compute mathematically the difference between these two frames. By extension, if you have a plate where nothing is moving and then somebody walks through, you can subtract every frame of the person walking from the frame where nothing is moving and get a difference matte – not a bluescreen matte or a greenscreen matte, but a motion matte. Very useful. For the bridge extension, we took a few frames before the explosion and averaged them out so we got a nice clean frame. Then we digitally subtracted that from the frames after the explosion began. The net result was just the explosion, which we could then matte over the composite plate.”

One aspect of the bridge explosion that Cameron liked best also created a dilemma. “The last detonation lifted the pavement slab right in front of the truck,” Cameron explained, “and the truck – which was really hauling ass – shot straight up it and did a two-and-a-half gainer, completely clearing the collapsed gap of the bridge and landing beyond it back on the highway. No one could ever have predicted that would happen. The truck was just supposed to disappear in the explosion and maybe we’d see a bit of wreckage coming down. What we got was breathtaking footage – but there was one problem. I had already shot the runaway limo scene and there was no truck on the bridge beyond the gap.”

The shot offered more than just continuity problems. “We never intended for it to be used to the very end,” stated Bruno, “so as the camera moved to follow the action, it just kept on going and panned off the edge of the bridge. Also, at the very end of the move, the camera picked up the matte box of the lock-off camera adjacent to it. But Jim wanted to hold onto that shot as long as he could. I told him to go ahead. We’d find a way to fix it – somehow. So he let the shot play and we had to deal with it.”

Mat Beck – who had photographed the shot – volunteered for the assignment. He had recently formed Light Matters, an entry-level digital boutique, and was eager to demonstrate his company’s capabilities in the feature arena. Bruno gave him the shot, which like most others in the film was first sent to Cinesite for digital scanning. “We had to extend the bridge and replace the area covered by the matte box. Edson Williams did most of the work using a mixture of CGI and image processing and a little bit of painting. To extend the bridge, we cloned sections from elsewhere in the frame, then repositioned and resized them. After that, we did some painting to seam the pieces together. We also had to add shadow elements to the last pylon – and the water underneath – since there was no bridge span beyond it. To erase the matte box – which was about a quarter of the frame near the end – we did a cut-and-paste job on the sky and synthesized the water out of a couple of different elements. Finally, we violated the matte line by throwing flying debris and some computer generated spray across it.”

To account for the truck’s absence in subsequent scenes, three surviving bridge stanchions – the outermost ones which had sustained minimal damage in Florida – were erected in the Digital



Struggling to fend off his assailant Harry momentarily loses control of the plane and backs it into a high-rise bank building across the street. A portion of the glass-faced edifice was replicated on stage at the hangar. The Harrier – mounted on a steel frame with casters that rode on tracks – was cabled to a tractor truck and yanked forcefully into the set.



In a shot filmed on the Miami rooftop, Aziz loses his footing when Harry tilts the plane sharply. Most of the motion base movements were performed in real time by effects engineer Mark Noel.

Domain parking lot and spanned with restored truss sections and a new road surface. “For it to cut with the stuff that had already been shot,” said Mike Chambers, “the truck had to emerge from a cloud of smoke and debris, land on its side, slide in a very specific way across the roadway and go over the edge. Richard Stutsman designed a pulley system to get the truck up to *Speed* and deliver it at the right angle. Air cannons were positioned to deliver debris. From the camera angles we needed – which were low – the rigging would have been visible in the rear, so we covered it over with white paper and had dense clouds of smoke blowing through. Behind the bridge was a sky backing in case the smoke broke up. Without it, we would have seen condos back there.” For lighting continuity, the scene had to be captured during a two-hour window prior to noon; but for an unprecedented three-week period, the Venice facility was enshrouded with morning fog that rolled in off the ocean three blocks away. When the weather pattern at last shifted, two attempts were made that failed because of subtle differences between the test truck and the hero truck. The problem was corrected, but others persisted and insufficient time remained to adequately finesse the shot. In the end, Cameron scrubbed the crash altogether and covered the narrative gap by having Light Matters digitally insert a greenscreen element of the smoldering truck – still on the bridge – into two of the live-action causeway shots.

Though the premier effects sequences had been retained by Digital Domain, three small, self-contained segments had gone elsewhere when the facility began divesting itself of excess workload. Given to Pacific Data Images were four shots establishing the chateau that Harry infiltrates during the prologue. Live-action was filmed at Salve Regina University in Newport, Rhode Island, a former grand mansion in the European style; and though the architecture was appropriate to the locale intended, the surroundings were not. “The chateau was supposed to be in Switzerland at the base of the Alps,” said PDI visual effects supervisor Jamie Dixon, “but the Alps were just a figment of our imaginations. I suppose those shots could be called matte paintings – certainly they hold the place that a matte painting would traditionally hold – but instead of paint brushes we used digital painting tools and a lot of photo compositing to make backgrounds that were more like collages than actual paintings.”

In the opening shot of the film, the camera trucks past a partially frozen lake and comes to rest on a snow-covered dock. Across the lake, bathed in moonlight and nestled at the foot of the mountains, is the chateau. The foreground was a miniature set built by Pat McClung and photographed against a greenscreen at Digital Domain. It and a live-action plate of the Newport mansion were sent to PDI where technical supervisor Barbara Meier – working with animators Cathy Wagner, Rebecca Marie and Larry Weiss – was charged with assembling the shots. “The chateau was a lock-off,” stated Meier, “which was okay – even with the move – because the chateau was so far away that there was no perspective change. All we did was track a couple of points to extrapolate where the vanishing point was and then slip the image accordingly. For the mountains in the background, we were given an armload of stock photographs – gorgeous 4x5s – that we used to make a selection of low-rez video mockups so Jim could pick the ones he liked. Oddly enough, the ones he chose were vacation slides I had taken on a trip in the Canadian Rockies. The final is actually a compilation of several different mountain ranges – treated day for night – with a fair amount of digital painting to make them fit together.” The moonlit lake surface was a 3-D computer graphic with shimmering water texture mapped onto it.

Other shots – likewise designed to establish the geography – included a closer view of the chateau as Harry cuts through a steel gate beneath the ice. “The tricky part about that shot,” noted Dixon, “was that there was a move on it and we had to make it look like the mountains were moving in proper perspective. On the plate, the area behind the chateau was all black – which was good – but there were moving searchlights on the roof and our mountains had to go in behind them. A searchlight glow isn’t something you can cut out with a roto matte, but we were able to put a haze over the mountains behind the lights to make it seem like they were actually in the scene. In addition, there were huge sycamore trees on the grounds – some of which skewered the mountains – so we had to pull a feathery luminance matte off those.”

The most difficult shot was a view of an Omega Sector surveillance van parked along a mountain road overlooking the chateau. “There are probably thirty or forty separate photographic elements in that shot,” observed Meier. “It had been planned as a lock-off shot, but when we got to the mountain location, Jim decided he wanted a move on it. So the foreground plate was shot as a track move – without pan or tilt – and because it was night, the background just fell off to black. The mansion was another lock-off plate. There was a whole rat’s nest of deciduous trees obscuring parts of it, so I did a massive digital tree removal. Then we put our own trees in, positioning them precisely where we wanted. In front of the mansion, the production had built four sections of stone fence that we had to extend for our shot. The far mountains were ones I had photographed on a trip to New Zealand; and between them and the mansion was a computer graphic lake defined by a sparkly surface. So there were a lot of little elements sewn together and then seamed with quite a bit of hand painting.” The fourth and final shot – a late addition – was from the same angle as Harry detonates an explosive device to cover his escape. A fireball was matted into the shot with interactive light effects painted onto the chateau and surrounding trees.

Though creating a Swiss chateau from a Newport mansion and a few travel photos was an interesting assignment, it is unlikely that PDI – with an ample slate of projects at the time – would have accepted it had it not been tied to another series of shots that Jamie Dixon very much wanted to do. “About five years ago,” Dixon remembered. “I did a simulation of the first atomic bomb test for Fat Man and Little Boy. It was a subject of great personal interest to me, perhaps because my father, as a young physical chemist, had been involved in the Manhattan Project at Los Alamos, but after some significant soul searching had left the field for something more humane. Unfortunately, the tools I had at the time were not really advanced enough to create the kind of imagery I wanted – and I guess, on a personal level, I’ve kind of been kicking myself ever since. Then along came Jim Cameron and *True Lies*.”

In each of his four prior films – everything since his *Piranha II* debut – Cameron had dealt obliquely or directly with the issue of nuclear armament. In two of them he had depicted nuclear blasts. *True Lies* was to be the third. “I suppose you could draw the conclusion that I think a lot about nuclear war. I guess I do. It’s something I’ve educated myself on quite a bit. While studying physics in college, I got a pretty good understanding of what happens from a



Snagged on a Sidewinder missile, Aziz dangles precariously after tumbling down the full length of the Harrier’s wing. Filmed on the rooftop with the motion base in plain view, the shot required exacting digital removal of

physics standpoint. Since then, I've been trying to get my mind around the moral perspective – the fact that out of three hundred or so nations on the planet, the United States is the only country ever to actually use a nuclear weapon against a human target. And the idea that all this stuff is still out there – and that the world is in this sort of collective denial – I find just amazing.”

the base plus the customary addition of heat signature and soot elements.

Harry disposes of his nemesis by launching the missile through the blasted-out floor of the high-rise and into a helicopter filled with gun-toting terrorists. A greenscreen shot of Art Malik was composited with trailing flame elements into a Miami background plate.

Discounting the fact that he was making a comedy, Cameron decided to incorporate into *True Lies* a scene in which the terrorists detonate one of their nuclear bombs as proof that they mean business. The blast occurs moments after the Harriers have blown up the bridge and Harry has rescued Helen from the speeding limousine. Having rediscovered each other at last, they fall into each other's arms and are engaged in a passionate kiss when the blast detonates behind them on the far horizon. Helen barely notices.

“I wanted to push some buttons with this scene and see what kind of reaction I got,” stated Cameron. “It was supposed to be like the fireworks out the window the moment Cary Grant kisses Grace Kelly in *It Takes a Thief* – only on a somewhat larger scale. Some people will find it inappropriate for a comedy. But if you take the whole movie very lightly, and appreciate its outrageous tone and the fact that it's really a marital fable, then the idea that Helen is so in love with Harry that she doesn't notice a nuclear explosion while they're kissing is pretty funny. At least I think so. Maybe one sort of perverse part of my mind says: ‘As a filmmaker, be a sophist and show that you can do anything with the same subject. Treat it as a technical challenge.’ In my last film, I did everything I could to really show the horror of nuclear war. You can't get any more serious or dramatic or grittily realistic than *T2*. So this time, why not play the same thing for laughs?”

Cameron's first inclination had been to take stock nuclear bomb footage and motion track it onto the horizon with enhanced glow elements. Dixon argued persuasively for doing it all with computer graphics. The two spent hours poring over a videotape compilation of nuclear bomb footage. “Each blast had a different aesthetic depending on the type of bomb and whether it was night or day or on water or land or dropped from an airplane,” said Dixon. “Because ours was out on a small island, it should have looked like the Eniwetok or Bikini tests – which threw up huge columns of water and had vapor domes around them – but the ones we tended to like best were the desert blasts that had more of a classic nuclear bomb look. Bits and pieces from several were used for our model.”

This time, technology had caught up with aspiration. “About a year ago, we developed some software that was really good at doing cloudy types of things – which was precisely what was missing on *Fat Man* and *Little Boy*. Our bomb shots in *True Lies* begin just after the initial flash. The stem and the cap are shown forming, and around the cap is a skirt of fire. The stem draws tremendous amounts of material into the cap, forming the distinctive mushroom cloud shape – which on the computer is a system of spherical elements moving in a circle, with random elements built in to mix them up and make them look jumbled. When the spheres are rendered, they look like clouds. As the cap rises, it twists and curls under on itself like a donut turning inside out. The skirt of fire is a similar donut shape, though made up of different elements that are more luminous and more transparent. Radiating out from the blast is a shockwave that spreads across the water.

The shockwave is a matte element that I used to put a little drop shadow on the water that races toward camera at roughly the *Speed* of sound. Above the bomb, I added regular old sky clouds to the shot. As the Shockwave expands, the clouds disappear – which is something we observed quite a bit in the test footage. In addition, since this is a very bright event happening in the distance, there needed to be little sparkly things happening on the surface of the water. By looking for pixels within a very specific range, I was able to pull out the natural sparkles in the ocean plate, then brighten them and color them and matte them back in to look like the reflection of the bomb.”

Though improved technology had allowed Dixon to create the bomb of his dreams, its placement in the shot was calculatedly understated. “The shot is not about the bomb – it’s about Harry and Helen not noticing the bomb. The plate was like a picture postcard. Arnold and Jamie Lee were kissing at screen right with the ocean behind them. At screen left was a palm tree. The bomb was to go off on the horizon between them. The plate presented some technical problems, however. It had been shot late in the day when light was low – in Vistavision – and so the background was way out of focus. To match it, we would have had to make the bomb the same – which neither Jim nor I wanted. Fortunately, someone had thought to shoot a clean plate – in case they had to do the shot greenscreen – and on that, the background was in focus. So we ended up rotoing Arnold and Jamie Lee out of the plate and comping them into the clean background with the horizon in focus.”

Harry leaps into action once again when he learns that Dana has been kidnapped by the terrorists. “As Harry runs around trying to figure out how to get downtown, Jim had the camera sweep the horizon a number of times so that the residual bomb effect could be seen in the distance. The camera’s not focused on it and it’s not being framed beautifully – but it’s back there, and that’s what really makes you think the bomb is real. For those three shots, the easy part was generating the continuation of the bomb – which at this point is tall and spindly. The hard part – tackled by Amie Slate, Sean Dever and Al Arthur – was the tracking and roto work. There are big pans. People are running in front of the bomb. Helicopters are in front of it. But those shots – throwaways practically – really sell the idea that a nuclear bomb detonated out in the ocean.”



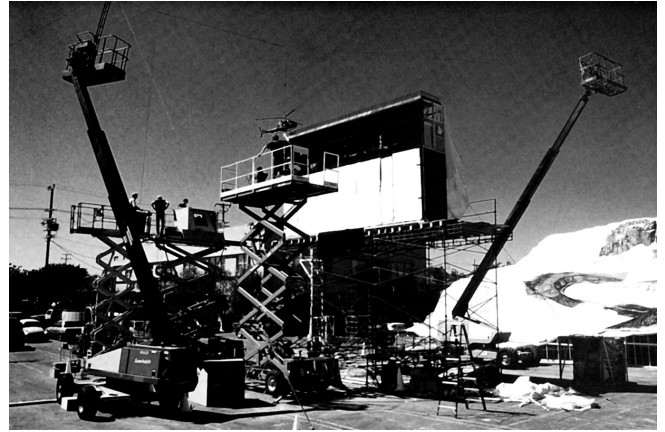
Destruction of the A-Star helicopter by the Sidewinder was accomplished in miniature in the Digital Domain parking lot. Larry Jolly observes as one of the six models he created for the shot is readied for its demise by Pat McClung and pyrotechnicians Joe Viskocil and Emmet Kane.

Another block of shots went to Boss Film Studios. Early in the film, an encounter between Omega Sector and the Crimson Jihad culminates in a wild chase through Washington D.C., with Aziz riding a motorcycle and Harry on horseback. Aziz drives through a posh hotel lobby and into a glass elevator that ascends to the roof. Harry follows doggedly, galloping his mount through a fountain and into an adjoining elevator. Trapped on the rooftop with nowhere to go but down, Aziz guns his motorcycle and drives through a glass guardrail, soaring over the street far below and landing in a rooftop swimming pool across the way. Not to be outdone, Harry tries to follow – but the horse has more sense than he does and comes to a screeching halt at the brink. Momentum propels Harry over the animal's head and leaves him flopping against the face of the building, clutching the reins and imploring the horse to pull him up.

The lobby pursuit was filmed in the Bonaventure Hotel in downtown Los Angeles. Cameron was at first disinclined to use the location because its distinctive cylindrical architecture made it a readily identifiable city landmark. But it did have the glass elevators that he wanted – and no other major hotel in Los Angeles, Washington D.C. or Miami was receptive to the idea of motorcycles and horses charging through their common areas. To disguise the building as much as possible – and convert it from a Westin hotel to a Marriott – Peter Lamont constructed a rooftop in the former Air National Guard hangar at the Van Nuys Airport, across the flight line from the Syncro Hangar. Built on a platform about twelve feet tall, the set was equipped with two hydraulically driven elevators and overlooked an expansive translight of Washington D.C.

Below the decorative glass railing at the edge of the set was a ramp. Both it and the area around it were draped with the greenscreen material. “I let the effects guys make the call on whether we used bluescreen or greenscreen on the show,” said Cameron. “The Harrier had a lot of blue in it, and the tests John Bruno shot seemed to indicate that greenscreen was the way to go. But for me, greenscreen was an even clearer choice for the hotel rooftop because it was night. It’s a lot easier to discriminate blue night lighting out of greenscreen than it is out of bluescreen. With greenscreen, we managed to keep the rich saturation in blue in those composite scenes – which traditionally is very hard to do.”

For the rooftop motorcycle jump, Tommy Fisher rigged explosive charges to shatter the tempered glass railing a fraction of a second before Jimmy Roberts drove through it. Vistavision plate cameras – locked off on cranes high above the set – recorded the action as Roberts made several jumps, landing his motorcycle safely on the ramp each time. Subsequent shots of Billy Lucas tumbling over the edge and Arnold Schwarzenegger dangling from the horse's reins, were recorded in similar fashion – but with a fiberglass stand-in for the horse.



Two high-speed cameras in protective housings are positioned to record the action. As a final step in the preparation process, Viskocil and Kane load gasoline bombs and primacord into the prescored helicopter suspended from a cable spanning two mobile cranes. Adjacent to the craft is the blown-out face of the miniature office building, which remained covered with foamcore until moments before the shot to prevent its plexiglass windows from warping in the sun.

The fake stallion had been constructed originally for use at the Bonaventure since no one was eager to see how a real horse would react to being lifted up a thirty-story building in a glass elevator. Its reemployment on the rooftop was to avoid injury to the real animal. Commissioned to build the horse was Makeup & Effects Laboratories. "We were able to use an existing fiberglass display model for the body," related company co-founder Douglas White, "but we had to modify it to match the real horse, which was about six inches taller. The head was sculpted and cast in foam latex so it could be articulated. All the horse had to do was move its head and its tail, but Jim wanted whoever was operating it to be inside because there wouldn't be room to hide external mechanics. Paul Elliott, our engineer, was the smallest of us; so he got elected. While he was designing the mechanics for the head and the neck, we reinforced the body with two-inch steel and sculpted the hair in bondo. Only the mane and tail used real horsehair. The butt area popped off so Paul could get inside. He had foot pedals in the front to make the neck go up and down and a three-axis stick right above him so he could use his arms to make the head move. Another stick behind him controlled the tail."

Mat Beck who shot the rooftop plates on stage, had earlier photographed the vertiginous backgrounds into which those greenscreen images would be composited. "We didn't want it to look like Los Angeles, so we synthesized the background. To tie in with the set, part of it was shot looking down from the roof of the Bonaventure, with the cylindrical glass towers and the elevators going up and down. From the side we were shooting, there was a plaza down below and not a lot going on. So we shot a different street in downtown L.A. – a busy street where the buildings looked older and more Washingtonian – and we put the two backgrounds together. To increase the sense of vertigo, we took some liberties with lens sizes and perspective to make the street look really far away." Since no rooftop swimming pools could be found in the high-rise district, a flattop building without one was shot, with the idea that a pool could be matted in. "We did a lot of lighting, but the area in frame was about nine square blocks, and there was no way we were going to be able to cover it all. So we shot at various frame rates in order to get enough exposure to pull various buildings up out of the shadows. Then the roto guys assembled the plate by pulling sections from different takes. We did the same thing with the street shots. We had a bunch of extras driving cars, and we simply had everyone drive very slowly so we could run the camera a little slower and get enough exposure."

Elements for the sequence were delivered to Boss for digital compositing. "The shot of the terrorist crashing through the glass is one that could never have been done acceptably until a year or two ago when computer compositing techniques really came into full force," said Neil Krepela. "Because the ramp created shadows, it had not been possible to get an evenly lit greenscreen under the motorcycle; so the plate actually had about five different shades of green. Only a computer could pull from that – and ours did. Every piece of flying glass is in the shot. That element was combined with others showing the face of the building and the street below – which were joined together with a little matte painting." Subsequent shots of Harry dangling off the side of the building were from roughly the same angle. "Even though all the plates were locked off, Jim likes to include a bit of natural movement in his shots – almost like they're hand-held, but subtle – so the last thing we did was add a little of that to the finished comps."

The reverse angle of Aziz flying out over the street and landing in the pool was more involved, as it required stage work in addition to element assembly. "We had the background plate shot in

downtown L.A. – mostly building tops. We also had a plate of a stunt rider jumping a motorcycle into a swimming pool – which was filmed at the Warner Ranch. We did not, however, have a plate of the motorcycle flying through the air. That we shot greenscreen on our stage. Since the motorcycle had to move away from camera and drop down, we built a tilting rig for it and shot it motion control. I calculated about a ten or fifteen degree down-tilt on the camera, plus a little bit of nose-up on the motorcycle as it came off the building. Then, as it fell away, the nose had to drop down so that when it hit the water, it was almost level – which is the way the stunt bike hit. At the same time, we mounted the whole tilting rig on a circular ball bearing so the motorcycle could turn horizontally, very slightly, to create a sense of changing perspective as it moved away. We shot it full-frame – at twelve frames per second to increase coat flap – and then reduced it in size and tracked it into the shot. On the swimming pool plate, we removed all the frames of the stunt cyclist up to the point where the motorcycle hit the water. Then we tracked our guy in and morphed into the spot where the splash occurred.” Also added by Boss was some computer generated street traffic far below and a small digital matte painting to blend the swimming pool into its adoptive setting. “Location scouts for years will be looking for this fabulous rooftop swimming pool in downtown Los Angeles.”

Even though other companies were called in to ease the pressure, Digital Domain developed tremendous momentum towards the end of postproduction, delivering more than one hundred digital effects shots for *True Lies*. For months, John Bruno had been wending his way through the maze of dimly lit cubicles examining workstation displays, making judgment calls and checking day-to-day accomplishments of the thirty-some digital artists dedicated solely to the project. It had been an unfamiliar world to a man whose background had been essentially optical. “My entire focus was what these shots were going to look like on film. I had to get used to how things looked on a video monitor. I got better at it as time went on, but I was never one hundred percent sure how to translate what I saw on a monitor to what I would see on film. That was my learning curve. Jacques Stroweis seemed to know exactly what the output would look like, as did Price Pethel. They were very comfortable with the technology. I was not. In fact, one of the things that struck me a month or so before we wrapped was the realization that we had about eighty shots in the computer. Those shots represented months of work – but they did not exist on film. They were little ones and zeroes in a sort of electronic heaven. Coming from my background, that was scary.”



Joe Viskocil detonates the two-part explosion as cameras record the blast. Six takes were required to successfully complete the shot.

James Cameron – a major force in effects films – was more than pleased with the debut performance of Digital Domain. “I think the composite work at the end of the film is pretty much up there with some of the best stuff ever done. There are a couple of weak shots – inevitably – but there are others that you literally cannot distinguish from reality other than to say that what you’re seeing is an impossible situation. And that’s a tough thing to do in full daylight. But technical excellence is only part of it. What we set out to do with Digital Domain was to make the work intuitive for filmmakers – to embrace them in a way that’s meaningful to them. Effects companies must get to the point where they can create a short enough feedback loop so that the filmmaker can order a change and be shown the results in a short enough time for it to be useful in the decision making process. The ultimate goal is to display real-time composite images – and though the technology to do that is not quite here yet, the video-rez composites and other tools we used on *True Lies* made the process fifty times better than it used to be. So in that respect, I think Digital Domain is already better than anyplace else in the business – but at the same time, I’ll add that it’s only about twenty-five percent of the way to where it needs to be. Communication is another issue. Effects people have to be able to communicate in a language that filmmakers understand. You can start a new company with a new philosophy, but you can never really start with an absolutely clean slate because there are only so many people trained to do this work and you’re essentially hiring from existing companies. These people are only as good as their experience, and their experience is to do things a certain way. So it’s going to take time to build the perfect effects facility – but we’re getting there.”

True Lies photographs copyright ©1994 by Lightstorm Entertainment and Twentieth Century Fox. All rights reserved. Production unit still photography by Zade Rosenthal. Effects still photography by Joe Viskocil, Don Shay, Don Pennington and Virgil Mirano. Special thanks to Stephanie Austin, Lisa Dennis, Steve Newman, Pamela Easley, Julia Gibson, Crystal Dowd, Bob Hoffman, Jenny Fulle and Nancy Nyberg.



The miniature footage was enhanced at Digital Domain with the addition of a computer generated Sidewinder – complete with terrorist – and exhaust trail.



An enormous fireball engulfs the A-Star upon impact.



His enemies vanquished, Harry Tasker lands the Harrier. With Arnold Schwarzenegger inside and Eliza Dushku tethered to the nose, the full mockup was lifted about thirty feet into the air with a crane and then lowered into

the shot as if it were landing. Cables supporting the plane were removed digitally and spinning turbines were mapped into the engine nacelles. Additional elements included heat signatures and blowing debris.

COMMERCIAL SPOT

‘THEY KEEP GOING AND GOING...’

article by Jody Duncan

Created by the Chiat/Day advertising agency, ‘Wicked Witch’ and ‘Vampire’ are the latest entries in the series of Energizer Bunny commercials which pit the dauntless drum-beater against legendary movie villains. In a forty-five second version of ‘Wicked Witch’, the Wicked Witch of the West character from *The Wizard of Oz* turns her menacing attentions toward the Bunny when she spots him in her crystal ball making his way toward the Emerald City via the *Yellow Brick Road*. Jumping aboard her broom and writing ‘Surrender Bunny’ in the sky, the Witch confronts the Bunny in the Wizard’s corridor. Advancing on him with her fiery broom, she inadvertently sets off a sprinkler system and – as in the original film – melts away to nothing but a steaming black cape.

Directed by Frank Oz for *Limelight* Films, ‘Wicked Witch’ – like the previous Energizer spots inspired by *King Kong* – required extensive visual effects in order to marry elements from the original film with new footage. *Sight Effects* and its computer graphics subsidiary In-Sight Pix were heavily involved in the production, supervising the shooting of visual effects plates on the set, generating effects shots and handling digital compositing in postproduction.

Practical elements shot on the stage by Oz and the *Limelight* crew included live-action sequences featuring a Margaret Hamilton/Wicked Witch look-alike, remote controlled mechanical bunnies – built by Eric Allard’s All Effects – and forced perspective sets that replicated the sets in the original film. “The sets in the real *Wizard of Oz* were huge,” *Sight Effects* executive producer Melissa Davies commented. “It is really a tribute to Frank Oz that he was able to create the illusion of size with sets that were quite small. The corridor where the Witch and the Bunny meet was only about ten feet long; but because of the way it was shot, it looks like it goes on forever.”

The spot opens with the Witch and her monkey henchman spotting the Bunny in the crystal ball. “She says, ‘I’ll get you my pretty!’ and a purple fog clouds the crystal ball,” noted Davies. “Then the Bunny dissolves up in the crystal ball and he is seen walking up the *Yellow Brick Road* toward the Emerald City.” The Bunny’s walk up the *Yellow Brick Road* was filmed live on a set that included a matte painting backdrop of the Emerald City. “There was also a practical crystal ball; but obviously there was nothing in there when they shot it. We wanted lights going through it, and we wanted to see a little reflection of the Witch and the monkey on top of the ball.”



In the latest series of movie-inspired Energizer commercials, In-Sight Pix digitally squeezed the drum-beating Bunny into a crystal ball belonging to the Wicked Witch of the West.

The reflections were captured on the real glass ball during the practical shoot. “That was the best way to get the correct reflections and highlights,”

stated In-Sight Pix supervisor Theresa Ellis. “The purple smoke was also practical. We could have created it in CGI – but it was there, they shot it, so we used it.” All the practical elements were then digitally manipulated. “We created a strip of the Bunny going down the road. We took this strip and started out with it full frame, then created a warping effect around the edges to make it look as if it was getting distorted through refraction, because of the ball shape. Elastic Reality – formerly ASDG – makes a morphing software that will basically warp a picture and make it look tight around the edges. It’s software that we’ve been helping to develop.” The software was also employed to track the Bunny footage. “It wasn’t true tracking – we didn’t take the coordinates of the frame and track them exactly – but that loose tracking actually looked better because it gave the footage a nice ethereal quality within the crystal ball.”

The digital artists also executed some timing changes on the Bunny footage. “We shortened it by eliminating some frames to move him up the road more quickly,” said Davies. The corrected footage was then composited into the crystal ball. “Theresa composited the Bunny in; and then, in the Harry, we took that and mixed it back with the reflections. Because they wanted it to look like the old movie – which didn’t have any reflections in the ball – we had to find a compromise between making it look like the old movie and making it believable. We had a lot of control over the amount of reflection we mixed back into this. We could have made it look very real, but the whole point of the project was to imitate the original movie as much as possible.”



In another spot the Bunny prevails over a vampire whose transformations from bat to human form were accomplished via traditional cel animation.

As the spot continues, the Witch flies out of the window on her broomstick. Next she is seen writing ‘Surrender Bunny’ in smoke. While the leap out the window was a live-action element photographed on stage, the subsequent shot of the Witch writing in the sky was footage lifted from the original movie. “We couldn’t get an original print of the movie,” said Davies, “but we were supplied video tape of it. In Harry we did some color correction to the footage – we mixed in a blue to bring the sky up a little bit, and we made the blacks darker. It is an old movie, so it was very washed out. For the next shot – which is her writing in the sky – we took the original ‘Surrender Dorothy’ and changed it to ‘Surrender Bunny.’ Again, in Harry, we took real pieces from the original plate and spelled out ‘Surrender Bunny’ using the same sky and the same smoke elements. We took the ‘N’ from surrender and made two of those for ‘Bunny’; we used the ‘Y’ that she is writing in the shot; we used the ‘U’ from ‘surrender’; and we used an ‘R’ and made it a ‘B.’ So it was just a matter of piecing it together.”

In contrast to the modern digital effects in the ‘Wicked Witch’ spot were the traditional effects methods *Sight Effects* employed for their next Energizer assignment, a takeoff on classic vampire movies. In the spot, a vampire rises from his coffin and transforms into a bat to go in pursuit of the Bunny. As always, the Bunny gets the best of his nemesis when the bat transforms back into the

vampire only to discover that he has been locked out of his lair. As the sun rises, the horrified vampire disintegrates in a puff of smoke.

The same production team of *Oz*, *Limelight* and *Sight Effects* worked together to produce the spot. “For the vampire’s transformation,” explained Davies, “we decided to use traditional animation rather than some kind of morph. It was a matter of going back to the old-style techniques of the thirties or forties, mainly because that style of effect fit in with the old style of the vampire movies we were emulating.”

Effects animator Angela Diamos was brought in to realize the cel animation. “We made a print of the plates of the mechanical bat and the vampire they had shot on stage,” Davies said, “and then Angela created the in-between scenes as the character transformed from vampire to bat, and then later from bat back to vampire. We projected the plates on an animation stand and Angela created the transition on paper with outline drawings. Then we took those drawings and painted them in Harry. We took the white from the vampire’s collar and the red from under his cape and used those to color these outline drawings. We also put in highlights on the bat. We did all that to the cels in the paintbox, and then we composited them over a clean background plate.”

Using the more traditional animation approach resulted in a different look than might have been accomplished through digital means. “We could have done a morph that looked rough and old-style,” said Ellis, “but what’s nice about the hand-drawn stuff is that it looks hand-drawn. It has that old look.” Such distinctions may be eliminated as animators become more comfortable with the new electronic medium. “If you have operators who are traditionally trained animators,” observed Davies, “they can add that character to it. And we’re beginning to see more of that in CGI.”

Having survived attacks by worthy opponents such as *King Kong*, the Wicked Witch of the West and a vampire, the Energizer Bunny is on a roll – as is Chiat/Day, with the apparent success of the innovative advertising campaign. And with the almost endless ranks of cinematic bad guys still to defeat, one can only speculate who the Bunny may next be pitted against. Bunny vs *Godzilla*? Bunny vs the Blob? Bunny vs *Frankenstein*’s monster? Stay tuned...

QUICK CUTS MAXIMUM SPEED

article by Jody Duncan

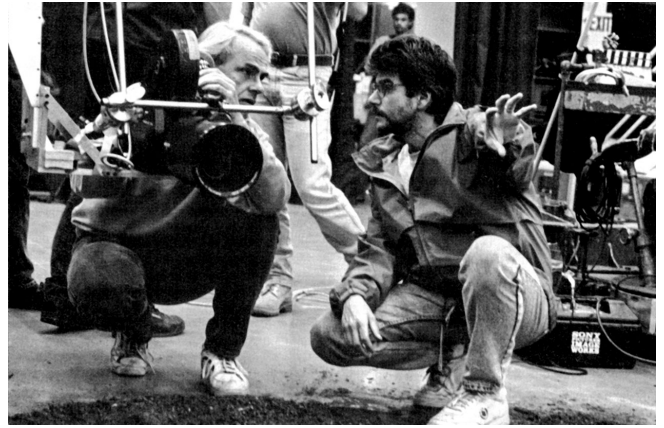
As a cinematographer, he bottled lightning for such celebrated action directors as Ridley Scott, John McTiernan and Paul Verhoeven. Now Jan De Bont has stepped into the directing arena with his own breakneck-paced film, *Speed*, a Twentieth Century Fox release. *Speed* pits Los Angeles police officer Jack Traven (Keanu Reeves) against Howard Payne (Dennis Hopper), a bitter ex-cop bent on exacting more than his meager pension from the City of Angels. When Jack foils Payne's plan to extort \$3 million in exchange for hostages trapped aboard a high-rise elevator rigged to explode, Payne plants a bomb under a city bus – a bomb that will detonate the moment the vehicle slows down to below fifty miles per hour.

Boyd Shermis, a visual effects designer who had collaborated with De Bont on a number of television commercials, oversaw the effects work for *Speed*. "Last summer," Shermis related, "Jan asked me if I wanted to do this film with him. It was the kind of thing I was looking to do: I wanted to do a feature film; I wanted to see where high-resolution digital technology was going; and I wanted to work with Jan."

Among the companies requested by Shermis and executive producer Ian Bryce to bid on the show was Sony Pictures Imageworks. "We were approached as early as last September regarding *Speed*," noted SPI executive producer Bill Birrell. "The bidding process went on throughout principal photography; and the job was finally awarded to us in February." Given a completion date of June 18, effects principals at SPI joined with Shermis and De Bont to begin defining the assignment. While much of the film's action would be achieved with full-scale physical effects – supervised by John Frazier – visual effects were to play a major role in three crucial sequences.

The first – a daring rescue of passengers from a booby-trapped elevator – is foreshadowed in the film's opening credits. "The title sequence is a long continuous shot moving down the elevator shaft," explained SPI effects producer Mickey McGovern, "with beams wiping the credits on and off. We filmed an eighteen-hour motion control shot on an eighth-scale model of the elevator built by Grant McCune Design. It was composited optically – by Jeff Matakovich of Optical Illusion – because it was four thousand frames and three-and-a-half minutes long. To do that kind of shot with a digital system would have been unwieldy."

The McCune model was also filmed by effects director of photography Garry Waller for the elevator rescue that opens the film. “The model was about eighty feet long,” McGovern explained. “It was a full elevator bay assembly which included eight elevator shafts and cars. The cars were electronically powered, and the entire model was motion controlled so that everything could move in a repeatable fashion. Some of the lights within the model were also motion controlled.”



At Sony Pictures Imageworks, director Jan De Bont and effects cinematographer David Drzewiecki line up a miniature shot for Speed.

In the sequence, Payne has planted a bomb on an elevator car carrying a number of passengers. From his makeshift command post within a freight elevator in the building, he threatens to detonate the bomb – which will destroy the elevator’s emergency brakes – unless his demands are met. As a warning, Payne sets off a smaller explosion which causes the elevator car to drop more than ten floors, leaving the passengers trapped precariously thirty-two floors above the basement. As the LAPD attempts to negotiate, Jack and his partner, Harry Temple (Jeff Daniels), stealthily attach a cable from a rooftop winch to the elevator car. When Payne acts on his threats and detonates the emergency brake, the weight of the car exceeds the capacity of the winch, which is dragged from its bolted position on the roof, causing the elevator to drop in a series of heart-stopping starts and stops.

While a four-story elevator set had been built on a Fox soundstage for live-action photography, the McCune miniature was employed for nearly all of the long up- and down-angle shots revealing the vertical expanse of the elevator bay. “The biggest problem with the elevator sequence from an effects standpoint,” noted Shermis, “was that for the live-action they could only build a full-size mockup that was so large. All of the more perilous angles – where you are looking down forty stories or traveling down a long distance or watching the elevator crash at the bottom – had to be created through effects. And we had to integrate those effects to cut in with the four-story mockup.”

The elevator sequence also included a bluescreen shot – the only bluescreen element in the movie – for a scene in which Jack rides atop the freight elevator carrying Payne and Temple, who has fallen inside. “In the shot,” Shermis explained, “we are traveling with Jack on top of the elevator at about ten miles per hour. We shot Keanu bluescreen, standing on a mockup of an elevator roof. The mockup was shaking a bit, just as an elevator would when moving, but otherwise it was stationary. Then we did a complementary motion control shot on the elevator model, traveling up the shaft with the appropriate matching angles. When we put those



Actor Keanu Reeves was shot bluescreen and composited onto a moving miniature elevator, with cables and lens flares added digitally.

two together, it looked as if Jack was traveling several stories up the shaft.”

Final shots in the sequence reveal the elevator dropping to the basement floor – mere seconds after its passengers have been rescued. Digitally composited into the shots were a computer generated cable and winch. “There was a winch that had been on the live-action set,” said CG supervisor Ron Brinkmann, “so we were able to measure that and create an equivalent model in the computer. We modeled the winch in Alias, then rendered it using RenderMan to create a photorealistic look and nice motion blur.”

Pyrotechnics were employed to enhance the elevator’s crash landing on the basement floor. “We composited in some pyrotechnics and some additional smoke,” Brinkmann related. “Mostly it was flashes, not actual flames, just to create an impression of an explosion. We shot a series of flash-frames to create a sense of the shaft being lit up by some sort of explosion; and those were animated in the computer, flashing on and off throughout the scene.”

Another effects-heavy sequence is the bus jump. After boarding the bomb-rigged bus, Jack is instructed by his LAPD colleagues to take an exit onto an empty freeway still under construction. Realizing too late that the freeway is not completed and that the bus is speeding toward an overpass with a fifty-foot gap in it, Jack instructs the layman bus driver Annie (Sandra Bullock) to floor it, hoping that with sufficient speed and momentum the bus will jump the expanse and land safely on the other side.

The bus jump was photographed on L.A.’s unopened Century Freeway. A stunt driver ran the bus up and off a six-foot-high ramp which had been dressed to replicate the paved road surface. Rising to a height of about ten feet, the bus traveled more than one hundred feet through the air. While a daring stunt in itself, the live-action bus jump was made less harrowing than the film version by the fact that there was no actual break in the freeway location. The gap, complete with a view of a sixty-foot drop, was created through a series of digital matte paintings.

Five shots in the sequence required digital matte paintings, including a wide establishing shot from a helicopter, ground-level shots revealing the approaching breach and a shot from the point of view of the driver. SPI was slated to complete all of the shots in the bus jump sequence, but when the movie’s release date was moved up from August 5 to June 10, Shermis brought in VIFX – the digital effects arm of Video Image – to complete two shots. “When the studio decided to move up the release date,” Shermis commented, “that truncated the whole back end of my postproduction schedule. And it put Sony Pictures Imageworks in an impossible situation – their schedule was cut nearly in half. So we took two shots from the bus jump over to VIFX – the helicopter shot and the bus POV. VIFX was well-suited to deal with those kinds of shots, and they did a great job on them.”

First in the sequence is the helicopter shot, photographed by aerial director of photography Ron Goodman of Spacecam Systems. “You are riding above the freeway and you’re looking down at the bus,” Shermis described. “The camera does a pan, tilt and zoom ahead of the bus, zooming in fairly tight onto a section of the freeway that has the gap. We photographed that from a helicopter with the Spacecam setup, doing the move on a real, completed freeway. Then in post, VIFX went in and tracked the camera move – which may have been one of the toughest things ever attempted in terms of tracking. They tracked the pan, tilt, zoom and helicopter shake of that entire fourteen-second camera move, and tracked it seven times for seven different layers of matte painting. We

added scaffolding in one layer, columns in another, and so on. So we had to create what amounted to a seven-plane matte painting. Richard Hollander of VIFX has a lot of insight into how those multiplaning type shots work. VIFX also has a Flame system, which has very sophisticated tracking software built into it. So they were able to go in and nail that part of it relatively easily.”

The digital matte painting work consisted of painting out a section of the freeway and replacing it with a background that suggested the gap was sixty feet in the air. “We replaced the freeway with a continuation of the construction site that was below it,” Brinkmann explained. “We didn’t go out and get totally accurate reference footage from the location because Jan wanted it to look more like a construction site than it actually was. In reality there were a lot of office buildings in the area, but he wanted more debris and trucks all around.”

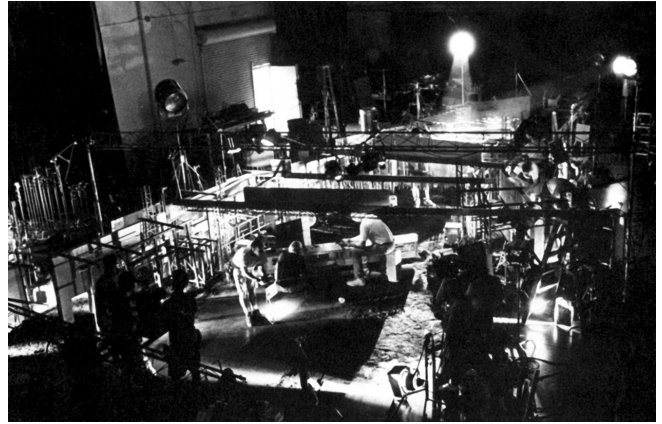
Digital matte paintings were also created for a shot of the bus POV. “In the shot, you are actually looking through the windshield,” said Shermis, “and in a very hand-held fashion, the camera pans around and ultimately tilts up to reveal the terminated edge of the freeway approaching. You see the gap and all this structure around it as you move toward it. Again, we took some hand-held photography and created the POV of the approaching gap. We had to track that photography – the motion of the bus and the hand-held camera motion. The fact that the shot was a POV through a windshield complicated things a bit, but not too much. All we had to do was give the painting in that area a little bit of distortion and add in reflections. Also, there was a wiper blade sitting on the windshield that cut right through the frame, so we had to restore that after we painted the background.”

Although two of the shots in the sequence – a profile shot of the bus in midair and a subsequent landing shot – were photographed with a locked-down Vistavision camera, SPI added camera moves in postproduction. “Once we had the paintings and everything composited,” explained Brinkmann, “we added a camera move to both of those shots so that they wouldn’t look locked off. We were able to do that because the Vistavision image was so large that we had room to move around in the frame. The landing was a bit more difficult from a technical point of view because the shadow of the bus had to be animated over the matte painting. We also had to add a fair amount of smoke and debris on top of that.” Additional movement was supplied by having computer generated birds flying through the shots. “It was the standard problem of making a matte painting feel as if it has some life in it. Video Image had added birds to their establishing shot, which really enhanced it, so we added CG birds to our shots as well.”



To simulate a fifty-foot leap, a bus was driven off a ramp, then incorporated into a digital matte painting of an unfinished freeway overpass.

Surviving the jump, the bus is finally routed to an unused runway at LAX where the passengers are unloaded in a daring vehicle-to-vehicle transfer. Once everyone is safely off the bus, Jack and the LAPD stake out the money drop point in order to apprehend the wily bomber. Payne outsmarts his adversaries once again, however, when he retrieves the money from an underground tunnel, taking Annie hostage as added insurance against police interference. The action of the film then moves to the Metro Rail subway system, where Jack and Payne have their final confrontation.



For the runaway subway finale, Sessums Engineering built eighth-scale rail cars and tunnel sets which were filmed at SPI.

As in the elevator sequence which opens the show, the train scenes were achieved with a combination of full-scale and miniature photography. “With the exception of a handful of shots where the train was going through concrete tunnels near the end of the sequence,” noted effects director of photography David Drzewiecki, “and a shot at the end when the train bursts out of a tunnel, everything else in the sequence was synthesized with model photography. Sessums Engineering built several eighth-scale trains and a complete mockup of the subway, down to the most beautiful detail. Metro provided us with all of the specifications for the train; and since we would be cutting back and forth from real trains to miniatures, we had to match what was used in the live-action exactly.”

Jack Sessums and his Sessums Engineering not only built two fifteen-foot-long trains for the sequence, they also constructed miniature underground tunnels. “Jack and his guys created a number of eighth-scale environments,” Drzewiecki recalled. “As the sequence progresses the train gets into areas that look as if they are still under construction, so Sessums created underground environments dressed with a lot of fuller’s earth, dirt and mud to give them an authentic look. Both the construction of the set and the lighting was based on cues from the live-action plates.”

The miniature rail system was used both for high-speed photography and for shots that would be composited with live-action plates of actors coming in close proximity to the out-of-control train. Background material for the latter category of shots was photographed in actual Metro tunnels by Shermis and his effects crew. “We had to light the tunnels because they were work-lit rather than film-lit,” said Shermis. “Other than that, we just went in and shot static Vistavision backgrounds of people reacting and getting out of the way – a normal live-action scene. Then we lined up the miniature train and choreographed it according to the action in the background plate. We had to take care that the lighting was interactive – that the train headlights affected the environment as they really would, and that the lights in the tunnels shone on the train as they would. So taking in all those cues, we lit and programmed the train. We shot the train as a motion control element, shooting a matte pass and a headlight pass and a beauty pass, and so on.”

The sequence concludes spectacularly with a shot of the runaway train crashing through a construction barrier, out into the street. “We shot a couple of camera angles on that,” said Shermis,

“again using Vistavision. The action was staged live on Hollywood Boulevard and we actually ran two-thirds of a train up a ramp and through a wooden barricade. We took what was directly behind that wooden barrier – actually a barren city street – and created the entire construction zone as a digital matte painting.”

With Payne’s decapitation in the subway tunnel and Jack and Annie’s final clinch, *Speed* comes to an end after two hours of nonstop action. The movie, which became an instant summer hit upon its release, was lauded for its roller-coaster-like sequences – sequences that were enhanced almost imperceptibly by the visual effects team. “I think the real value of visual effects,” observed Bill Birrell, “is in what they can add to non-effects movies. Creating visual effects for big science fiction or fantasy films is a challenge, but it is almost more satisfying to create effects for films that are not in those genres. The filmmaker can imagine anything – like a bus jumping over a fifty-foot expanse – and we can make it happen.”

CLOSEUP

ADDING TEETH TO WOLF

article by Tim Prokop

The mythology of the *Werewolf* has been well explored in the movies. In the thirties, the legend was introduced in *Werewolf of London*. The forties gave us Lon Chaney, Jr. in *The Wolf Man* and a slew of sequels. The nuclear paranoia of the fifties set the stage for *The Werewolf* with its science-gone-amok spin. Succeeding decades have been duly represented by *Werewolf in a Girl's Dormitory*, *The Werewolf of Washington* – with the *Werewolf* legend as a metaphor for the Watergate scandal, no less – and *An American Werewolf in London*.

Now, in a decidedly nineties telling of the tale, Columbia Pictures and director Mike Nichols have presented *Wolf*. The project had its origins in an unusual incident that befell novelist Jim Harrison at his remote mid-western cabin. After dreaming that he had run over a wolf in his car, the author awoke to the hallucinatory sensation of rubbing his hands over his face and feeling fur and a snout. Harrison recounted the experience to producer Douglas Wick who encouraged him to develop it into a screenplay. Two years later Harrison had a script that he showed to personal friend Jack Nicholson, who loved it.

With Nicholson's star power behind him, Wick engaged Academy Award winner Mike Nichols to direct. While an unparalleled master of both drama and comedy, Nichols had never before explored the horror genre or directed a film that was heavy in special effects. But neither Nichols or Nicholson wanted *Wolf* to be a typical horror film, or a film where the effects took center stage. Both believed strongly that *wolf* should be a character piece that focused primarily on the inner changes that would take place if someone were actually to be transformed into a savage animal.

That message was conveyed very directly to animatronic masters Tom Woodruff and Alec Gillis of Amalgamated Dynamics Incorporated when they first met with Nichols and Wick more than two years before photography would begin on *Wolf* "We wanted to start building a transformation head for Nicholson," said Woodruff, "but they said: 'No, no, no! That's not what this movie is about.' There were, however, a lot of other things that made the project interesting for us; and it was great to have the opportunity to work with Mike Nichols. The kind of work we do doesn't usually get handled by a director of his caliber."

Making the experience even more rewarding for Woodruff and Gillis was the fact that their creative input was welcomed. "Often, we're just seen as guys that do fake heads and rubber bodies," said Woodruff, "but we can contribute much more if people are willing to trust our ideas and listen to them. We were involved in trying to figure out a reason for the character's transformation and the fact that the adrenaline surge in his body when he's angered or threatened is what hastens the process.



We thought that was an interesting concept that hadn't been explored in this type of movie."

While investigating makeup possibilities with A.I, Nichols also explored his options regarding visual effects with Scott Farrar and Eric Brevig of Industrial Light & Magic who served as consultants throughout the film's development and photography. "It was something of a unique experience for us," said Farrar, "in that we weren't discussing specific shots, but rather the possibilities for visual effects. We were there to provide advice and give Mike a palette of effects and techniques that he could choose from."

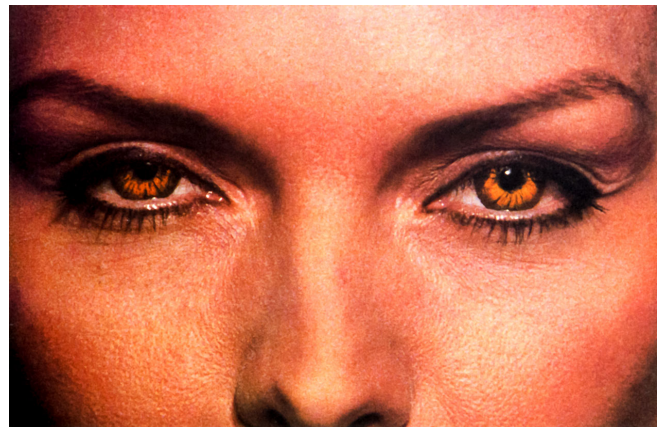
Makeup effects master Rick Baker was also involved in discussions with Nichols and Wick early in the development process. "It was a different kind of movie from what I expected," recalled Baker. "As soon as I read the script, I knew it wasn't going to be about putting a lot of rubber on Jack Nicholson – not when you have someone with a face like his. Mike agreed with that; but I was preparing to do another film and the schedules didn't mesh, so I regrettably had to say no to *Wolf*." Months later, the other project was abruptly canceled, allowing Baker to rejoin the production just two weeks before shooting was to begin.

Like all Columbia features, *Wolf* opens with a statuesque woman holding a shimmering torch aloft. Clouds sweep across the screen, obscuring the iconic image before the main title jumps out at the audience, the jagged white 'W' stabbing toward the bottom of the frame like fangs. The 'O' in the word 'Wolf' is equally apt, a full moon that shines down upon book editor Will Randall as he drives along a snow-covered New England road.

The title sequence was done collaboratively between RGA/LA and Pacific Title, using photographic elements created by Sony Pictures Imageworks. "Pacific Title rotoscoped the leading edge of the clouds as they pass in front of the Columbia lady," explained RGA/LA visual effects producer Chip Houghton. "The clouds wipe off the lady, and we brought up the titles and created a digital transition from the letter 'O' to the moon – which was a miniature built by Grant McCune and shot by SPI."

Built originally for the television movie *Out on a Limb*, the moon model had since appeared in numerous films, commercials and stage productions. McCune started with a fiberglass hemisphere – fifty-four inches in diameter – upon which he drew patterns representing familiar lunar landmarks.

Wolf begins with Will Randall being bitten by a Werewolf he has struck with his car. Amalgamated Dynamics built an animatronic animal to interact with actor Jack Nicholson.



Though primarily a makeup show, *Wolf* also featured visual effects. RGA/LA contributed a digitally manipulated shot of Jack Nicholson – done specifically for the trailer – which wound up being used in the film. Sony Pictures Imageworks added eye glows to a shot of Michelle Pfeiffer.

Next he coated the hemisphere with spackle and sculpted relief. "I kept the spackle slightly wet and worked on it like it was a wet clay sculpture," stated McCune. "Then I took it out into the sun and splashed droplets of water on it from ten feet up. I also threw balls of clay at it to create craters."

Given that *Wolf* tells the story of a man who becomes a *Werewolf*, it is hardly surprising that the moon is a recurring motif in the film. The lunar images that hover above much of the action were created at SPI by effects producer George Merkert and visual effects supervisor John Nelson. "We couldn't have shot the real moon and had it look as good as the model," Merkert commented, "because if you have to expose for clouds in the foreground, you lose the detail on the moon; and if you expose for the moon, the clouds just become silhouettes. It is much more effective to go on stage and shoot the moon with visual effects techniques."

Nichols provided SPI with a list of the different phases of the moon that he wanted. Working from that list, effects director of photography John Fante lit the model to represent the moon on specific days. "John was able to light the model for any point in the lunar cycle simply by moving a light that simulated the light shining on the moon from the sun," stated Merkert. "The clouds were created by Al Marangoni who can control smoke and fog better than anyone I know. We shot miles and miles of footage to create those few shots of the moon, using different frame rates and combinations of smoke, dry ice, liquid nitrogen and bridal veil to get the right look."

The moon is full when Randall drives around an icy curve to find a wolf staring at him from the middle of the road. "They first tried to create this shot without a visual effect at all," Nelson recalled, "by conditioning a real wolf to stand still while a car pulled up to it. Then frames could be subtracted to increase the speed of the car and make it look more realistic. However, they couldn't move the car fast enough to make it look believable without injuring the wolf."

To solve the problem, a plate was shot through the window – from the driver's viewpoint – with a full-size mannequin standing in for the animal. Tim Douglas then animated it digitally. "I digitized one still image of the wolf in the live plate, then cut it out and made it into a number of texture maps that I applied to a three-dimensional wolf shape in my computer. I used that information to animate the wolf so that it took a step as the car approached. I also added motion blur to make it more realistic. I wanted the wolf to turn its head toward the car, so I took a stock picture looking straight at a wolf and morphed between that and the side view to create the illusion that the wolf turns its head."

Unable to stop in time, the car slams into the transfixed wolf – actually a full-body replica built by A.I. Woodruff and Gillis conducted extensive research into wolves to help them create a puppet that would look authentic, yet have subtle human qualities suggesting its lycanthropic nature. "We read lots of books on wolves and viewed all the videotape we could find," recalled Woodruff. "We even shot some of our own at a place that supplies animals for movies. That gave us a solid base of information to work from; but we really wanted to go somewhere different with it and put some humanity in the wolf to imply that it's the result of some earlier transformation."

"A wolf's facial plane is more streamlined and aerodynamic than ours," Gillis explained. "So to make the wolf look more human, we brought the cheekbones forward, made the brow a bit more prominent and set the eyes deeper. Then we found an interesting photograph of a person and duplicated his eye shape on the wolf."

To withstand the impact of the car, the dummy wolf was built around an aluminum wire armature. “The wire was strong enough to allow us to position the limbs as if the wolf was caught in mid-stride,” Woodruff noted, “but flexible enough to give rather than break when it was hit. The car was driven into it several times, and the wolf survived without a scratch. It looked kind of silly in dailies, but we knew that somewhere in those four or five minutes of footage there were seven or eight frames that would prove very effective.”

SPI enhanced the footage by animating facial expressions and other movement onto the dummy wolf the instant before it is struck. “Doing this digitally allowed Mike Nichols to film the shot a number of times without damaging or exposing the delicate animatronics that would otherwise have been required to create those movements,” Merkert remarked. Animator Lisa Adamson used Elastic Reality to move pixels and define the movement and motion blur required for each frame. “I considered using footage of a real wolf,” commented Adamson, “but because of the facial differences, it was impossible to find footage that I could match to the dummy. I took a single frame from the start of the sequence and used Elastic Reality to make the wolf crouch on its forelegs, pull its ears back, crinkle its nose and open its lips in a snarl just before the car hits it.”

A subsequent shot of the wolf impacting with the windshield was achieved by filming in reverse. Gillis and Woodruff positioned themselves out of frame on either side of the vehicle and bounced the dummy against the glass as the car traveled backwards. Natural momentum and the movement of the car propelled the wolf over the front of the hood and onto the road. When printed in reverse the wolf appeared to flip upward and strike the windshield before it was flung over the top of the vehicle.

Shaken by the incident, Randall gets out of the car and approaches the stricken animal – a full animatronic puppet created by A.I. He prods it with a stick and assumes it is dead when it fails to respond. The audience is warned otherwise, however, when the wolf momentarily opens one eye and then closes it before Randall notices.

The mechanism for the eye movement was concealed by a clear vacuform shell which Gino Acevedo painted white to create the sclera of the wolf’s eye, leaving the center clear to reveal the iris and pupil. Using a single-strand brush, Acevedo then painted realistic veins and color splotches onto a silicone membrane which had a hole in it that was stretched over a black delrin form. When the wolf turns its baleful gaze upon Randall, the pupil expands as it focuses upon him. This was accomplished through a mechanism – built by Dave Kindlon and Jon Dawe – which pulled down the edges of the silicon membrane, widening the hole in the center. “It’s as if you stretched a sheet of rubber with a hole in it over a basketball,” Gillis explained. “The more you stretch it, the wider the hole will open, so more of the basketball will be revealed. We didn’t want anything too mechanical; so this was the perfect solution.” Fitting the mechanism into the eye was the most challenging part of the work. “It had to be a very small, very intricate mechanism – with tiny levers and gears like watch parts. Jon did amazing work to get so much finesse into something that size. Luckily, Mike Nichols saw the dramatic value of it and shot the eye in extreme closeup.”

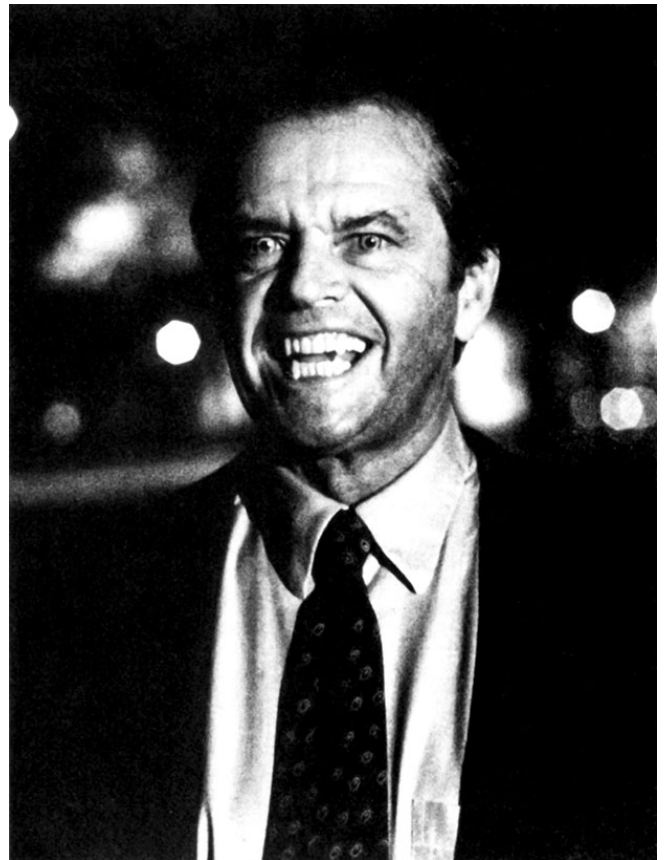
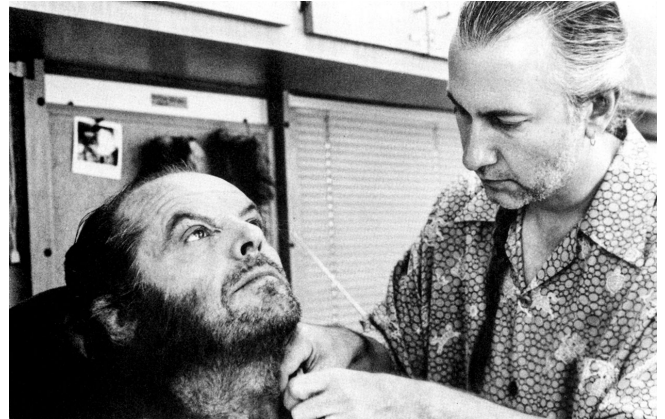
While the original wolf’s eye shot lasted only two seconds, it was extended in postproduction when Nichols decided that a longer duration was needed to create dramatic tension. A simple solution was to run the same shot forward and then backwards to double its length. Doing so, however,

caused the pupil to dilate and then constrict, making the reverse printing apparent. To circumvent the problem, Nichols had SPI manipulate the image digitally so that the pupil remained open throughout the extended shot.

In addition to eye movement, the animatronic creation was capable of other lifelike expressions. “What really makes an animatronic puppet come to life is when you have an overlapping or a blending of different movements,” Gillis observed. “For example, when we have the wolf blinking, it’s not just a movement of the eyelids; it’s the movement of the eyelids, plus the movement of the brow, a squint mechanism underneath the eyes and the movement of the eyeball itself. It really becomes lifelike when all of these movements are blended and choreographed.”

Achieving this lifelike choreography required extensive practice and rehearsal among the nine puppeteers who combined to animate the wolf. Four used joysticks to operate the radio-controlled face, while the remainder used cable pulls to create the wolf’s body movements. “We used radio control for the face because the movements were subtle, so there wasn’t major stress involved,” explained Gillis. “For the neck, body and limb movement, we used direct cable because we needed the extra strength. The wolf had fully functioning front legs so that it could struggle and writhe on the ground, a breathing mechanism, spine movement, neck movement, head movement and full facial function – snarls, snapping jaws, brow movement, blinks and ear movement. It was probably the most complicated animatronic puppet we’ve ever built.”

Defining the shape of the body was a fiberglass shell which was covered in soft foam latex to give a natural appearance to the skin and fur. Creating realistic-looking fur proved challenging, because of the natural coloration that wolves have. “If you look at a wolf up close,” observed Woodruff, “you’ll see that its overall color is created through many different colored hairs that are all mixed together.” To create a convincing wolf coat, Lisa Rocco used synthetic fur from National Hair Technology – a firm that supplies hair that can be premixed by color on a percentage basis. “National Hair Technology has a computer program that allows them to provide an exact color mix that can be made up of many individual colors, which was ideal for our wolves,” stated Gillis. “There might be a gray strand next to a



To depict Randall’s descent into lycanthropy, Rick Baker designed a series of understated makeups that began with

brown strand next to a black strand; and when you step back, it would give the wolves that very specific salt and peppery look.” The same color breakdown

yellowish contact lenses and enlarged canine teeth and progressed to full lupine dentures and copious facial hair.

was used on the faces of the wolves, which employed crepe wool, rather than synthetic fur. “It’s a traditional material used for fake beards. Lisa was able to hand lay it so densely that she could cut it back to one-quarter or one-eighth of an inch without it looking choppy or having bare spots.”

Unaware that the wolf is still very much alive, Randall attempts to drag it to the side of the road. Suddenly, the animal leaps to its feet and bites Randall on the hand before fleeing into the woods. The leaping up and running away was performed by a real wolf. “We didn’t even attempt to have our animatronic wolf stand up because it would have been very difficult to pull off mechanically,” noted Woodruff. “There were also some limits to what our wolf could do because the script had changed after we built it. Originally, its back legs were going to be crushed so that it would bite Randall and die right there in the road. But that was changed to a more dynamic scene where the wolf gets up, bites him and then runs away. It was much easier to do this with a real animal; and the cuts are so quick that the facial differences between our wolf and the real one aren’t noticeable.”

To create a startling closeup as the wolf lunges toward Randall, a wolf head with a vicious snarling expression was sculpted. Once cast and furred, the head was fitted with a hand grip for easy manipulation and cable-controlled jaws that snapped open and shut as the wolf attacked. The bite was accomplished with a real wolf which was prompted to attack a stuffed glove at the urging of the production’s animal wrangler. SPI was called upon to add digital snow to the shots of the real animal so that it would more closely match A.I.’s snow-dressed animatronic wolf. Tim Douglas used a three-dimensional animation system to build a series of shapes in his computer that approximated the side of the real wolf. He then added texture maps of snow taken from other frames in the film and matched these to the animal to make it appear as if snow is clinging to the wolf’s fur. Finally, he animated individual sections of snow to create the illusion of snow falling off the animal as it rises. “Fur has an uneven surface,” stated Douglas, “so the three-dimensional patches of snow had to be oriented at different angles to the side of the wolf to make them look believable. Positioning the snow was tricky because this shot wasn’t intended to be an effect, so it wasn’t filmed with a locked-off camera. I had to use the 3-D animation system to make sure that my digital camera matched the camera move, and then match the snow to the side of the moving animal.”

After biting Randall, the wolf runs to join its pack mates at the edge of the woods. The grouping was comprised of two real wolves plus five full-body replicas created by A.I. These included three complete background wolves, a cable-controlled wolf with head and neck movement, and an animatronic 'Nicholson' wolf that was created for the end of the film. "Mike Nichols really liked those Brandenburg nature photographs of wolves, where all you see is half of a wolf face behind a tree trunk or eyes through bushes," Gillis recalled, "and we tried to capture that look with our wolf pack."



To highlight the eerie intensity of the wolves' gaze, soft eye glows were created by Lisa Adamson and Deborah Wiltman of SPI. "Since you couldn't see the wolves' eyes in the live-action plate," said Adamson, "we created some glowing eyes for them with a paint program. Then we tracked them to the movement of each wolf's head – no easy task in a panning shot that was 350 frames long with lots of perspective changes."



Nursing his wound, Randall drives home to a world in which he seems destined to fall victim to people who are more ruthless and aggressive than he. This destiny is averted when Randall begins to experience the mental and physical changes that result from the wolf bite. At first these appear to be beneficial – more acute hearing, keener eyesight, a sense of smell that can detect a lingering hint of tequila on the breath of a coworker. But there is a dark side to Randall's gradual transformation as well, a danger he does not at first recognize.

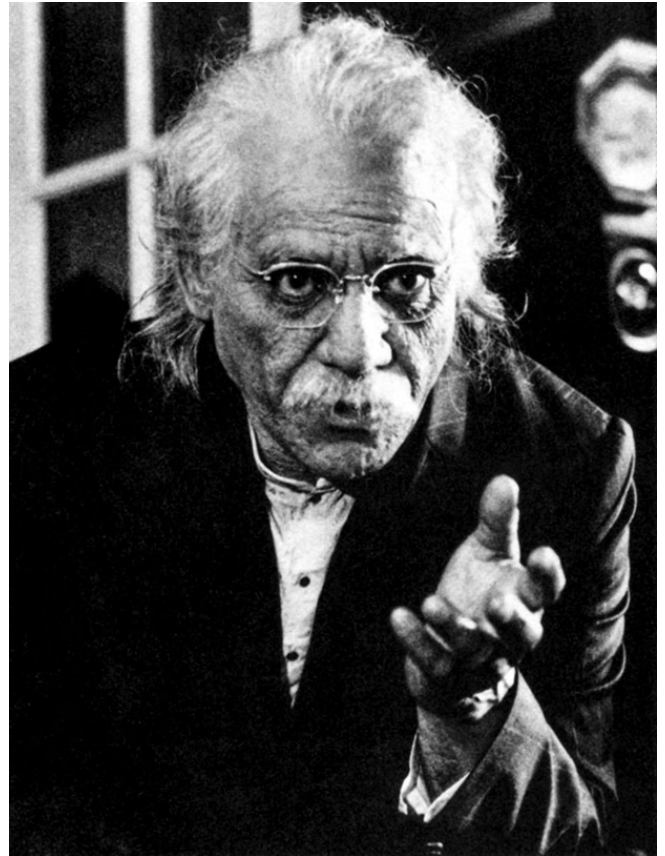
A primary benefit from his bite is a newfound sense of youthfulness, both in energy and appearance. The physical aspects were achieved by Steve Abrums – a makeup artist who works regularly with Nicholson – and hairstylist Alan Dangerio. "Steve did a terrific job of making Jack look younger through careful shading along his jaw line and by using beauty makeup techniques," Rick Baker noted. "He was helped by some terrific toupees created by Peter Owen, who makes the best hair pieces I've ever seen. On Jack's other films, they've gotten away with just darkening his scalp; but that wouldn't have been enough for *Wolf*. There had to be a noticeable change in his appearance."

After being rejuvenated by Abrums – which could take up to an hour – Nicholson would spend another one-and-a-half to three hours with Baker who added the subtle makeup effects that highlighted Randall's transition into a wolfman. "When I first met with Jack, he wanted to do it completely without makeup," Baker recalled. "I agreed that there shouldn't be too much, but I also felt there had to be something to make it believable. We did a makeup test and Jack felt that we were thinking along the same lines, so I started planning the different phases his character would go through." Baker mapped out the changes in Randall's appearance through a series of illustrations that he created on his computer using Photoshop, which allowed him to manipulate photographs and experiment with different looks for the character. "I started with a normal photograph of Jack and drew what I thought the most extreme makeup would be. Then I did one between those two, and additional in-between drawings until I had a series of sketches that I could match to different scenes in the script. Mike didn't want to go as far with the makeup as I envisioned, so we ended up using more of the sketches at the Nicholson end of the spectrum."

The changes were accomplished largely by laying increasing amounts of hair on Nicholson's face, with three subtle appliances used for the final stages of his devolution. "When I was just a kid," Baker recalled, "I was told to practice my hair work because it is a skill that very few makeup people can do well – and that advice really paid off on Wolf. Most of the hair work I've done lately has involved implanting it in rubber rather than on a person, so it took me a while to get the hang of it again. I got out my hair, stood in front of a mirror and started laying it on myself to try and figure out what I was going to do."

Baker experimented with different types of hair to determine the best one to use for the character. "Usually when you lay hair on people, you use yak or human hair; but in this case, I wanted something softer. I tried crepe wool, which had a great look, but the color range was too limited. I ended up using Angora, even though it's very difficult to apply because it's so straight. To make it easier, I crimped the hair in an antique fluting machine – the type once used to put bends in collars – and straightened it again once it was on Jack's face." Further complicating the process was the fact that Nicholson is highly allergic to spirit gum, Baker's adhesive of choice for gluing down loose hair. "I used 355 medical adhesive on Jack, which made the makeup a little more difficult. One day, I made the mistake of using spirit gum, because I'd just finished making up someone else with it; and the next day Jack came in with welts all over his face from an allergic reaction. Any other actor would have had a fit, but Jack was really cool about it." For shots of wolf-like hands, Nicholson wore a pair of spandex gloves. "They had little finger cups with claws in the end. For closeups, I laid on the hair and created a makeup out of my kit."

In the most advanced stages of makeup, ear pieces were employed, along with a subtle appliance that widened the bridge of Nicholson's nose and gave his eyes a more wolf-like slant. Contact lenses made by



Baker also rendered middle-aged Om Puri an old man and devised progressive Werewolf makeups for James Spader.

Dr. Richard Silver of Professional Visioncare Associates altered the actor's eye color in a range of yellowish tones that increased in intensity with each progressive makeup. Randall's teeth also evolved gradually over the course of the film, his canines becoming more prominent and finally developing into fangs. "We started with very subtle caps that you can hardly tell are there," stated Baker, "then moved to a set with enlarged canines. We had another set that had the teeth behind the canines also enlarged, plus four stages of complete upper and lower dentures fitted with more extreme teeth that protruded from his mouth in a frightening way."

When Randall first becomes aware that his senses are more acute, he steps outside his office and stands in fascination on an inner balcony, his ears moving about subtly as he focuses in on distant conversations all around him. The effect was achieved through small radio-controlled 'ear movers' created by Steve James. "The ear movers looked like some kind of space probe," remarked Baker. "They had small arms attached to acrylic shapes that fit in back of Jack's ears. As he tried to locate each sound, his ears could be moved independently in different directions. If we had made huge ear movements, it would have looked silly; but they were subtle, so I think it works."

The first time Randall appears as a wolfman is at the estate of Laura Alden (Michelle Pfeiffer), the daughter of the magnate who has taken over the publishing house where he works as a senior editor. During the night, Randall is awakened by the enticing scent of a small deer grazing outside. The deer flees through the woods and Randall gives chase, dodging trees and leaping over logs with inhuman agility before he finally tackles the luckless animal. Because of the physically demanding nature of the sequence, the pursuit was staged using stuntmen. Two performed running scenes while a third, gymnast Keith Campbell, created spectacular leaps and jumps with the aid of an air ram. Because all three were cast for their athletic abilities rather than any resemblance to Jack Nicholson, each wore a Nicholson mask while performing. "Andy Schoneberg, Aaron Sims, Matt Rose and I sculpted full-head foam rubber stunt masks," Baker explained, "making them with different expressions so they wouldn't look the same for every scene. The masks looked pretty good in long shot, which is how they were designed to be filmed."

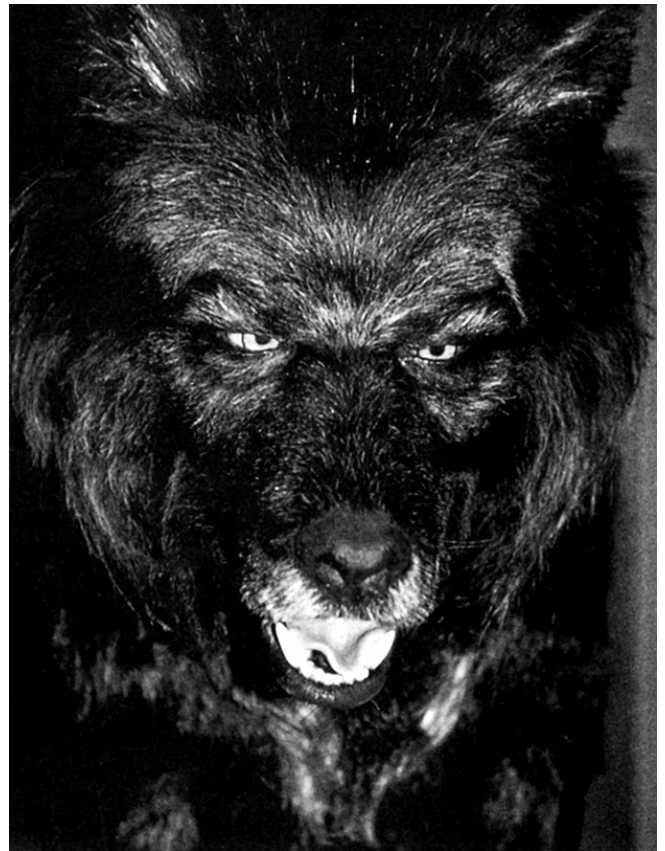
Although the deer chased through the woods was a real animal, a deer dummy was used for the scene in which Randall's high-flying dive brings it down. Scenes showing Nicholson wrestling with the animal and finally biting its throat were accomplished using an animatronic deer provided by A.I. "It would have been impossible to film the sequence with a real deer," Gillis noted, "because deer have very thin legs which could have easily broken. There was also the risk that Jack could have been kicked with razor sharp hooves while he wrestled it. To avoid those problems, we built a full-body stunt deer for the tackle and a half-body animatronic puppet for the wrestling closeups."

Unlike the animatronic wolves, the deer puppet was animated entirely through cables which controlled the movement of the neck, body, legs and mouth. "There was so much thrashing and gross movement in the scene that fine movements would have been lost anyway," Gillis noted, "so we opted for a simpler approach. It also helped that deer aren't all that expressive – they always look kind of scared, which was something we aimed for in our sculpting." The mechanism that animated the deer was built by Jeff Edwards out of aluminum and steel shafts joined by pivots. "Jeff made a very beefy mechanism that could withstand being thrashed around. The neck he made from a section of tentacle that we built for *Tremors*, reworking it to provide the movement we needed."

Upon viewing the puppet, Nichols revised his plans for photographing the deer. "Mike originally wanted to see blood," explained Gillis, "but when he saw our puppet he decided that would be taking it too far. He thought it looked so real that people in the audience would have screamed 'Bambil' and walked out of the theater." Nicholson was equally respectful of the animatronic creation. "Jack came over to us and said: 'You guys made this thing. How does it work? What can I do to it and what can I not do to it?' We told him what to watch out for and which body position looked best. The legs had a nice kicking movement; and once we showed that pose to Jack, he hit it every time."

When he awakens in the morning, Randall recalls nothing of his nocturnal hunt; but the blood covering his face and chest gives him ample reason to seek the help of a specialist, Dr. Vijay Alezais (Om Puri), who presents him with an amulet to help him fight his transformation into a wolf. The forty-two-year-old Indian actor was transformed into an ailing and elderly man through a makeup created by Rick Baker. “Frankly, I was hoping they would cast someone older for the part,” Baker admitted. “Om Puri has jet black hair that starts around his eyebrows and he is absolutely full of life; so I knew it wouldn’t be easy to make him appear old and sickly. It also didn’t help that he was in Bombay and wasn’t readily available for a lifemask.” When Baker finally got his opportunity to create a lifemask, the issue of the actor’s claustrophobia quickly surfaced. “He couldn’t put his face under water, let alone under plaster. Mike wanted him to be bald with thinning white hair, but we couldn’t shave his head because he was on five movies in India at the time. We ended up making a foam rubber bald cap that we combined with a wig by Peter Owen. The rest of the makeup came out of my kit through stretch-and-stipple latex that I painted very carefully. I was pleased with how it looked; and Om Puri delivered a very touching performance that made all the extra work worthwhile.”

Reluctant to accept what he has been told by Alezais, Randall declines to wear the amulet that evening, and the moon again releases his bestial nature. Prowling through Central Park, he encounters three hoodlums who choose the wrong victim to rob. The bloody confrontation that follows was enhanced with an effect RGA/LA created for the *Wolf* trailer. “The teaser was originally to conclude with a snarl by Jack Nicholson in makeup,” Chip Houghton recalled, “but Columbia thought it needed more impact. So we took the photographic element of Jack snarling and created a series of twenty-four segments of about four frames each that isolated different parts of his face. We digitally created a



Amalgamated Dynamics built animatronic wolves for the production, including one with an intentional resemblance to Jack Nicholson.

camera zoom on each point of his face that we selected and used Photoshop to create a radial blur effect around those points.”

The segments were compiled into a finished sequence by J&G Productions which collaborated with Columbia to produce the teaser. “Once they put it all together and added sound, it looked very impressive,” said RGA/LA visual effects supervisor Stuart Robertson. “It brought some kinetic energy to what had been a very straightforward film image.” Nichols was so impressed with the final imagery in the teaser that he had it edited into the film as a dynamic precursor to Randall’s attack on his would-be assailants.

Again unaware of his nocturnal sojourn, Randall finds a grisly reminder in his coat pocket the next day – a pair of human fingers. Shortly thereafter, he learns that his estranged wife has been found with her throat torn out. Though he fears himself responsible, Randall later discovers that the killing was done by his back-stabbing colleague Stewart Swinton (James Spader) who is also transforming into a wolf after having been bitten earlier by Randall.

“Mike initially wanted me to make James up the same way I did Jack,” said Baker, “but I really felt that I had to put rubber on James to bring him up to Jack’s level. James has this perfect young face, whereas Jack has this craggy old face with tons of character. I hated the first makeup test I did on James – I thought it made him look like Eddie

Munster. I was in my shop looking at videotape of the test, shaking my head when I got a call from him. He said, ‘I know you’re a great makeup artist, but I really don’t like this makeup.’ I told him I agreed, and between us we convinced Mike to take the makeup further than just laying on hair.”

The first stage of makeup for Spader was the most subtle, with only the application of loose hair, contact lenses and teeth. “As he becomes more wolf-like, I added cheekbone appliances, a stronger neck, wolf ears and a forehead piece. Eventually it got to where most of his face was covered in rubber. The most advanced makeups took almost five hours to apply.” An encounter between Laura and Stewart at a police station – the first scene in which Swinton’s lycanthropic state is revealed – was shot very early in the production. “This was one of the first scenes we filmed that was supposed to be a little heavier in terms of makeup. I told Mike that I needed time to add some loose hair, beard stubble and contact lenses to James’ face. Mike was afraid that even this simple makeup would be too much, but I really felt it was needed because two minutes later he’s a full-blooded wolfman who is ripping people’s throats out.”

Alarmed by Spader’s behavior, Laura returns to her father’s estate where Randall is voluntarily locked in a horse stall, struggling to fight off his total transition into a Werewolf. Swinton follows her to the property, becoming more wolf-like by the second, as revealed by a shot looking in through the



A.I fashioned puppet replicas of Nicholson and Spader that could open their mouths much wider than humanly possible.

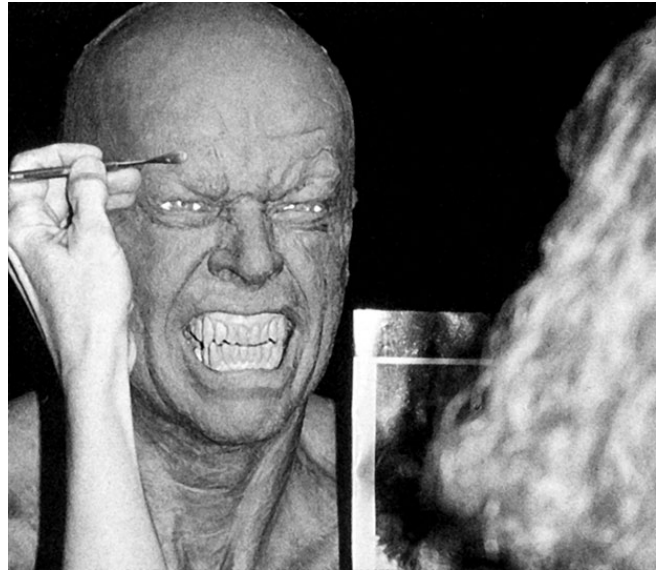
windshield of his car. Because of the dark illumination required to make the scene believable, the yellow contact lenses worn by Spader failed to register. The matter was corrected at SPI where Lisa Adamson pulled mattes and digitally altered Spader's eye color to match the intensity of previous scenes.

Swinton gains entrance to the Alden estate by running down the guard at the entrance to the property. After slaughtering a second guard, he corners Laura in the barn, in front of the horse stall in which Randall has been locked. Having successfully fought off the transformation thus far, Randall is faced with an impossible choice. Either he can remain human and watch the woman he loves be destroyed, or he can remove the amulet and undergo the transformation that will allow him to save her. Randall opts for the latter course, developing wolf-like hair and teeth in a series of quick cuts. With newfound strength, he leaps over the door of the horse stall to confront his nemesis.

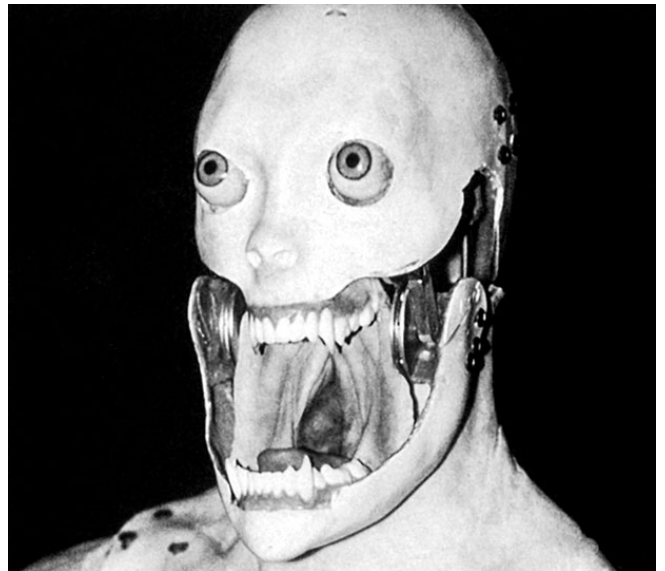
Measuring each other in canine fashion, the wolfmen face off until Randall suddenly lunges forward. To heighten the impression of speed and rage, SPI digitally combined Nicholson's image with footage of a puppet head created by A.I. "Mike really wanted that frenetic snapping movement that occurs when two dogs push their faces together to try and position themselves for the bite," said Woodruff. "We knew they couldn't ask two major stars to slam their heads together, so we created cable-operated fight heads."

The puppet heads – which also included upper torsos – were sculpted by Linda Frobos from life-casts of the actors taken in neutral poses. To aid her in sculpting suitably ferocious expressions, Gillis and Woodruff took photographs of Nicholson and Spader making the most vicious faces they could. "Linda used the photographs as a reference," Gillis said, "but tried to increase the intensity of the expressions by about ten percent so the heads would have more dramatic impact." Yuri Everson used the finished sculptures to create molds that allowed the puppets to be cast in translucent silicone, which was determined to be a better representation of flesh than was foam latex. Among the difficulties posed by the material was finding an effective way to paint it without obscuring its natural translucency. Gino Acevedo prevailed by impregnating the color between thin layers of silicone that were applied with an airbrush, sandwiching the pigment within the material itself. Once the silicone was cured, hair was added by Karin Hanson who punched it in with a needle. "Karin did most of the hair on the top and back of the head with multiple strands," Woodruff said, "but the hair on the face was all done single strand, one at a time."

The heads were finally fitted with fierce wolf teeth sculpted from castings of the teeth created for the actors by Rick Baker. A cable-operated hinge mechanism operated the jaws, stretching the surrounding silicone to open the mouths wider than any actor could naturally duplicate. "Human jaws pivot in one place," remarked Gillis, "but we added a second pivot to give us an incredibly long stretch as the characters open their mouths to bite each other." Joystick control allowed cable operators to turn the heads in various directions, while a push rod created additional movement by stretching the necks outward. "Because of the type of action that was required, we wanted the heads to do more than just lunge toward each other. We wanted to have the neck elongate to take advantage of the natural elasticity of the silicone and to make the sequence more exciting."



Linda Frobos sculpts the Nicholson puppet.



Underskull and mechanics for the head.

Once the puppets were completed, Woodruff and Gillis showed Nichols a video demonstration. “Mike looked at it for a few minutes, but didn’t seem very enthusiastic,” Woodruff recalled. “We thought we’d disappointed him until he finally asked if this was the puppet head he was looking at. Mike thought he’d been looking at Jack Nicholson in makeup!” Nicholson’s response was equally gratifying. “He took one look at the tape, and said: ‘Great, finish the movie with this. I don’t have to wear that makeup again!’”

For the fight scenes, each puppet was rigged to a backpack that supported the weight of the heads and made it easier for the operator to create natural movements. Woodruff, the lead puppeteer for the Nicholson head, controlled the forward pitch of the chest with one joystick and the movement of the neck with another, while Jon Dawe performed a similar function for the Spader head. A second puppeteer for each used levers to open and close the jaws, while a third activated the tubes that released blood and methylcellulose saliva. Performers positioned out of frame provided the hands that grapple and claw during the clash. “We built shoulders and forearms for the heads and fitted them with velcro straps that went around the forearm of the hand doubles who were wearing Rick Baker’s wolf gloves,” said Gillis. “We only see the characters from the shoulders up, so this was a very effective way to create realistic hand movements and tie them to the head actions.”

Unable to gain the advantage, Swinton attacks Randall with a pitchfork. A closeup of its tines scratching Randall’s face was accomplished with A.I.’s Nicholson head. Baker then made Nicholson up with bleeding scratches, adding similar cuts to his stunt masks to ensure continuity. Swinton next drives the implement deep into Randall’s shoulder, an effect that was created using a pitchfork with retractable tines built by special effects coordinator Stan Parks. A shoulder harness concealed beneath Nicholson’s shirt held the pitchfork in place as Randall appears to pull the weapon out of his shoulder. After viewing the dailies, Mike Nichols decided to heighten the action by redoing the scene using the Nicholson puppet head. “We added a torso to the head and shoulders,” Gillis recalled, “and an arm made out of rigid urethane foam so that Mike could take a wider angle as the pitchfork goes in. Stan Parks sharpened a real pitchfork until the prongs were needle sharp and fitted it to a pneumatic ram. It was the meanest looking device I have ever seen. The camera was



Karin Hansen punches hair into the figure.



Gino Acevedo colors the translucent silicone skin.

running at sixty frames per second as they fired the pitchfork into our puppet. We opened the mouth extra wide and threw back the head in a howl of pain. It looked phenomenal, but Mike wasn't able to use it because the pitchfork sank in so deep that it didn't match the less effective stuff that was shot live on the set."

Although wounded, Randall manages to hurl his adversary against the stone steps of the house. Swinton grabs a pair of gardening shears and leaps high into the air to stab them into his opponent's unprotected back. Unlike the previous leaps in the film which were accomplished with the aid of an air ram, this jump was assisted by wires that were digitally removed by SPI. This allowed Nichols to photograph Spader in closeup as Swinton rises into the air and is shot by Laura. In the film's only transformation shot, the dying Werewolf's hairy paw changes back into a human hand.



Puppeteers animate the animatronic heads during shooting of the finale.

The transformation was achieved at SPI by lead animator Scott Kilburn, who morphed between three separate film elements. "They shot a plate of Spader's hand in full wolf makeup," said Kilburn, "a second plate that was midway between human and wolf, and another without any makeup at all. I used Elastic Reality to outline the wolf hand and slide the pixels around to create a morph to the in-between hand. Then I created another morph to the human hand and digitally adjusted everything to effect a smooth transition."

In defeating Swinton, Randall has been forced to unleash the bestial impulses he has been trying so hard to contain. He flees into the woods as if striving to outrun the memories of a life that now appears lost to him forever. Randall is last seen as a fully transformed wolf with a disquieting similarity to Jack Nicholson – an impression that A.I. took great care to create through their sculpting. "We used a lifecast of Jack as a reference and measured the angle and spread of his eyes so we could duplicate them exactly," Woodruff stated. "The eye mechanism was the one we built for the wolf that gets hit by the car, and the payoff came when we saw dailies of a very long tracking shot that they did, closing right in on the wolf until its eyes fill the frame. There were four minutes of this in dailies; and we kept waiting for the image to fall apart as it became obvious it was animatronic, but that never happened."

Wolf concludes with Laura Alden remarking that she can smell alcohol on the breath of one of the detectives investigating the deaths on her property. As she turns to smile at him, her eyes take on a yellow tinge that suggests she is in the midst of a transition that will soon reunite her with Randall. The yellow glow was added at SPI by Tim Douglas, who isolated the actress' eye color in his computer, then did a digital search to help track the movement of her eyes – a process complicated by the fact that Laura walks through areas of light and shadow during the scene. Once the tracking was completed, Douglas pulled mattes of the eyes for each frame and digitally altered their color to create a soft yellow glow.

The subtlety of the final eye glow was characteristic of a movie which took a 'less is more' approach throughout. "This could have been a big effects film," Tom Woodruff remarked, "but Mike Nichols isn't a big effects director. He's a character and story director, so that's what *Wolf* came to be about. I think Mike really upped the class of this film, because it's not about slobbering monsters and blood; it's about a guy coming to grips with his altered reality when he learns that he is actually becoming a wolf."

Rick Baker more involved in the hands-on makeup than he has been in many of his recent films, also found *Wolf* a rewarding, if demanding, project. "Wolf kind of reminded me of my roots when I first got into makeup through independent films and had to try and work magic out of my makeup kit. The hours were long and it was really hard work; but it was also kind of fun in a perverse sort of way. I think the *Wolf* makeups looked good and they helped Mike Nichols tell the story he wanted to tell."

COMPANY FILE

MAKEUP & EFFECTS LABORATORIES

article by Estelle Shay

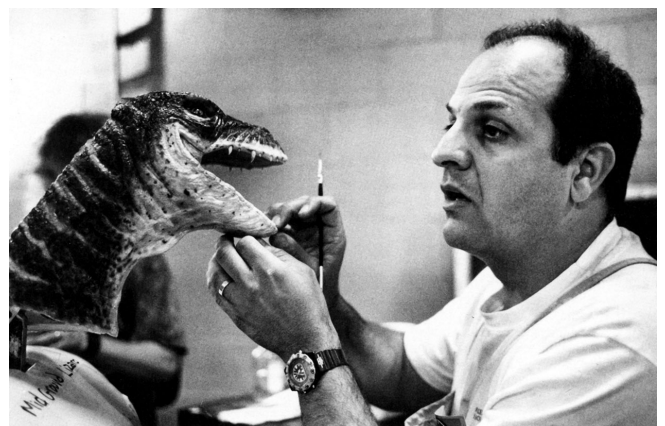
Ask any effects artisan what inspired his or her interest in the field and most will respond with childhood memories of building and photographing makeshift model sets in their parents' garage or fashioning experimental monster makeups on school-age friends. Such is the case with Allan Apone and Doug White, devotees of makeup effects and best friends since childhood. "Doug had been interested in makeup effects ever since he was ten years old," Apone recalled. "We met in junior high, and he would do all his test stuff on me. I was his guinea pig."

Working in the hobby craft industry in 1979, Apone was introduced to prominent makeup artist Tom Burman, who was filming *Prophecy*. Both Apone and White joined the project, doing mold-making, general shop labor and some sculpting. "When the assignment was finished, we couldn't find any more work. There were really no other shops around, the industry being what it was at the time. So I said: 'Let's start our own company. We can do all the low budget stuff.'" Despite the duo's minimal film experience, Makeup & Effects Laboratories was born.

The fledgling enterprise cut its teeth on several Roger Corman productions, including *Galaxy of Terror*, one of their earliest assignments. Initially tasked with constructing a giant maggot, the partners were later hired to oversee the film's special effects makeup as well. Other Corman projects followed, including *Sorority Massacre*, *Return to Horror High* and *Space Rangers*. "Working for Corman was a valuable learning experience," said Apone. "You don't make a lot of money, but you never have to worry about getting paid." Over the years, the shop established a reputation as a job-out house, contributing effects to more than twenty-five feature films in addition to television and commercial projects. "Bigger companies would come to us because they didn't have sufficient space, time or staff. Or they would send us stuff that needed to be repaired or reworked."

Faced with increasing competition, MEL began to diversify, recruiting a third partner, John Fifer, in 1985, and moving into related effects disciplines such as props and costuming. "John came to us from a fine arts background, so he was great at designing props and sets. As a SAG actor, he has also breathed life into a number of characters we've created – such as Toad in *Super Mario Bros* and Bigfoot for a recent PM Entertainment project."

Besides contributing to traditionally effects-oriented features like *Star Trek V*, *The Addams Family*, *The Coneheads* and the TV series *Star Trek – The Next Generation*, the company has also worked on non-effects projects. "In 1983, we did a film called *The Golden Seal* in Vancouver," recalled Apone. "They had spent almost a year trying to develop special gold makeup for the seals. We were only supposed to be on the film for a couple of weeks; but when we came up with something that worked for the seals,

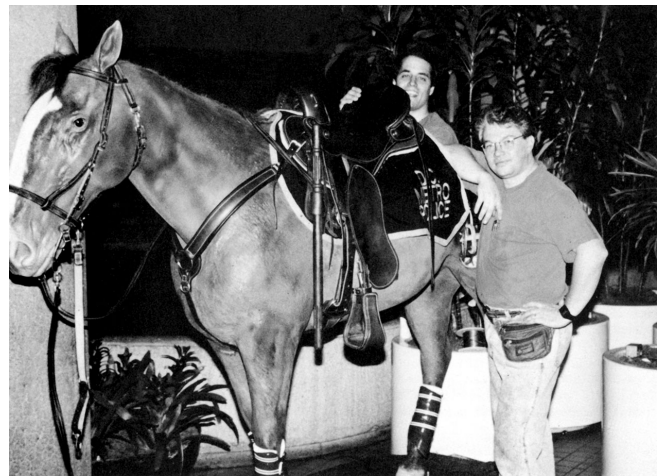


we ended up staying on for six months.” Following that success, MEL found itself doing more and more animal-related effects. Among their more unusual assignments were creating rat costumes for forty dachshunds in *Deadly Eyes* and adhering porcupine quills to an unfortunate canine in *Homeward Bound*. For *The Fisher King*, Doug White spent seven weeks on location creating makeup effects for the Red Knight’s hellish steed featured in a fantasy sequence. “We took a white horse,” said White, “and dyed it completely orange using a red henna rinse; then added accents and shadow effects with airbrushing.”

Allan Apone of Makeup & Effects Laboratories adds detailing to one of the Goombas his company created for *Super Mario Bros*.

MEL was also responsible for the more conventional makeup effects that transformed actors into the historical figures they were portraying in the acclaimed Civil War epic *Gettysburg*. The remarkable likenesses were illustrated in the film’s title sequence where images of the actors dissolved into their real-life counterparts. Ironically, the work drew fire from a Los Angeles Times critic. “He said Tom Berenger looked like ZZ Top and Jeff Daniels looked like a walrus,” Apone remarked. “All he did was critique the style and not the craftsmanship. That’s what those people looked like. I’m very proud of our work on that film.”

In 1992, on the big-budget fantasy *Super Mario Bros*, MEL launched its most ambitious undertaking to date. Bidding on the mechanical effects work required to build the film’s legion of big-bodied, tiny-headed Goombas, the company won the assignment despite an inauspicious start. “When we initially interviewed for the job,” Apone recalled, “we didn’t think we were going to get it because we had no big animatronics we could show that would convince them we could handle the project. So the next day we went back to our shop and built a full-size maquette – sculpting the head and mounting it on a mannequin dressed to look like the character designs they had shown us during the interview. We took pictures of the maquette and had them delivered to the production office. Shortly afterward, they called and said if we wanted the job that badly, it was ours.”



Engineer Paul Elliott – with MEL cofounder Doug White – takes a break from his duties inside a mechanical horse built for *True Lies*.

To complete the assignment, the partners assembled a crew of forty and set about building the reptilian characters – utilizing every square inch of space in their shop. Fifteen different Goomba models were constructed, including six fully mechanical closeup versions equipped with full-range facial features, another six with limited facial movement for mid-range shooting and the remaining ones for background shots and stunts. Ranging up to eight feet tall, the mechanical models were operated by a puppeteer inside a suit who controlled head movements and jaw movements, while other facial articulations were radio-controlled from the outside. The huge Goomba body – outfitted in vest and coat – consisted of a harness surrounded by a pod to retain the shape of the character,

with the operator sandwiched inside. Designed so that most of the weight was carried on the puppeteer's hips, the suit – though heavy – could be worn in relative comfort.

Conceived as background characters, the Goombas so delighted Super Mario's filmmakers that they decided to expand their role – even establishing one as a principal character. "The project was a huge success," Apone remarked. "Everyone fell in love with the Goombas and they performed flawlessly. There wasn't anything that was asked of us that we couldn't do; and the more they saw we could do, the more screen time they gave us." Although the picture's lackluster performance at the box office proved disappointing, the effects company's contribution did not go unnoticed. "All the writeups on the film mentioned how great the Goombas were. Consequently, we're doing a lot more mechanical work now."

A recent project in that mechanical vein was the construction of a mechanical horse for James Cameron's summer blockbuster, *True Lies*. White and his crew built a full-size horse with articulated head and tail for a high-rise rooftop sequence. Also for that project, MEL sculpted two foam latex Dobermans for a comic quick-cut in which attacking guard dogs are knocked unconscious by secret agent Arnold Schwarzenegger. "When they did the scene with the fake Dobies on location in Rhode Island," White recollected, "Arnold knocked their heads together and their eyes popped out. The weather was so cold it had compromised the glue we used. Someone said, 'This is a problem,' and John Fifer countered with 'Listen, if you had your head smashed by Arnold Schwarzenegger, your eyes would pop out, too!'" Despite that initial glitch, the replicas passed the ultimate test when they even fooled the real dogs. "The first time the Dobies spotted one of them leaning against a tree, they jumped it."

After fifteen years of solid experience in what has become a highly competitive arena, Makeup & Effects Laboratories is busier than ever and vying for future prestige projects. "We want to be known as an 'A' list company," observed Apone. "Our workmanship is 'A' list quality – but we seldom get 'A' list movies." Looking to expand beyond their current 6500-square-foot facility, the partners have no intention of letting size stand in their way. "We may not be the largest effects house in L.A., but we have all the skills, the staff and the equipment to do the job. It's just a matter of people giving us a chance – of saying, 'Okay, here's your shot.' That's what was done for us on *Super Mario Bros*, and we really came through."

PROFILE

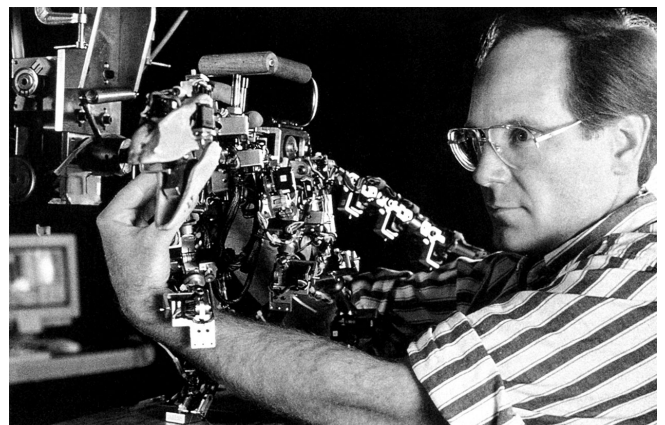
Randal M. Dutra

article by Estelle Shay

For wildlife artist Randal M. Dutra, the divergence of his talents into the field of visual effects was never actually by design. Growing up in Castro Valley, California, Dutra began drawing and sculpting at an early age – mostly dinosaurs and monsters, owing to a typical childhood fascination with such classic movies as *King Kong* and *The 7th Voyage of Sinbad*. “I was just nine years old when I saw *Sinbad* for the first time, and was absolutely mesmerized by it,” Dutra recalled. “Coincidentally, living across the street from me was Randy Cook, now a successful effects artist, then a high school student animating and sculpting in his parents’ garage. Randy took me under his wing, answering a barrage of questions about *Sinbad* and related topics.” More than the budding interest in effects, however, it was Dutra’s delight in the mysteries of the natural world that provided the strongest impetus for his artistic inclinations. “When I wasn’t building clay figures and animating them on the dining room table, I was basically running wild in nearby Lake Chabot Park. I think my love of nature is what prompted me ultimately to pursue a serious study of drawing, painting and sculpture.”

Following high school, Dutra attended the prestigious Art Students League in New York City, then apprenticed under sculptor Jose de Creeft, a former roommate of Pablo Picasso, and modern masters such as Robert Lougheed, George Carlson and Bob Kuhn. In 1981, while working in a foundry learning the art of bronze casting, he received a call from an acquaintance who happened to head the creature mold shop at Industrial Light & Magic. “He asked if I’d be interested in dropping by to take a look and possibly working as a mold assistant,” Dutra recalled. “I had some commitments; so several months passed before I was able to take him up on his offer. When I finally did, it was almost like a homecoming. Just seeing the plethora of creatures they were working on put me back in touch with a lot of aspects of my childhood.” What particularly impressed Dutra was that the sculpted creatures indicated some understanding of natural design. “They weren’t just cooked up. That’s what hooked me; because, with all my work in nature, I could see that here was a vehicle for that knowledge.”

Working under stop-motion specialist Phil Tippett in the creature shop at ILM, Dutra spent the next year – both in the studio and on location – working on *Return of the Jedi*. The assignment led to additional effects work with Tippett, and the young artist soon found himself entrenched in a whole new artistic endeavor. During the next twelve years, his film contributions would cover everything from designing creatures, sculpting, molding and fabricating to puppeteering and animation. His credits ranged from commercials to more than a dozen feature films for television and movies,



including the Emmy Award-winning documentary *Dinosaur!*, *Gremlins*, *RoboCop* 1 and 2, *Willow*, *Ghostbusters II*, *The Golden Child* and the highly acclaimed full-length animated feature *The Nightmare Before Christmas*.

Randy Dutra – who devised the choreography for Jurassic Park's principal dinosaurs – animates a raptor input device at Tippett Studio.

In 1991, Dutra embarked on his most ambitious assignment to date. Recruited by Tippett Studio as a senior animator for *Jurassic Park*, Dutra would devote one and a half years to the project; and the experience would become a career high point. "I had worked with Phil for more than a decade, and he was always very generous in leaving me to my own devices as an animator, designer and sculptor. So when this opportunity came along, it was like a dream project – not only because of the technological breakthroughs, but also because we were to portray dinosaurs not as monsters, but as living, breathing animals. I knew I'd be able to draw on a lot of the information I'd been accumulating through the years." Joining the project during its lengthy preproduction, Dutra was tasked with establishing *tyrannosaurus rex* and *velociraptor* character traits and movements. As sole animator on preproduction research, he conducted animation tests that would later become a movement bible for all subsequent live-action and production animation discussions. "We spent a lot of time gathering the correct reference material – going back to nature documentaries and studying animal movement then deviating from that once we had a foundation. Fortunately, we had the rare commodity of preproduction time to work out problems and get it right, which made all the difference. This was a huge boost to the subsequent quality seen in the film."

Once animation tests were completed and movement guidelines established, Dutra's remaining efforts in the film were concentrated on animating key shots for the raptor kitchen sequence and the T-rex attack on the main road. "Animating the two raptors entering the kitchen was a perfect example of employing nature as a reference," said Dutra. "I based their respective movements on wolf behavior, adding some bird-like accents. So that was a case in point where I knew right where to go to make the sequence believable." A similar approach was used for the scene in which the T-rex attacks a tour vehicle. "We designed that shot to resemble vulture behavior. The T-rex strikes at the overturned car much like a vulture would strike the soft underbelly of its prey, gutting it while securing the carcass with its talons. No less challenging were the raptors leaping on and off the aluminum kitchen countertops." In addition to working out key movements for the full-scale dinosaur models, Dutra and animator Tom St. Amand also collaborated with ILM on the computer graphics shots that figured prominently in the movie. "It was my first exposure to CGI, a kind of crash course or baptism by fire," Dutra recalled. "But the wonderful details we were able to achieve really couldn't have been done in any other way or have had the same impact – things like muscle contractions, varying skin flexibilities, shifting of muscle masses when weight is planted. With CGI, we could accomplish all these aspects with absolute control. It was an incredibly successful melding of art and technology."

Since *Jurassic Park*, Dutra has been on a mini-sabbatical aimed at getting back to basics and further honing his artistic skills. "There's a certain irony in the fact that film work – particularly with the advent of computers – is primarily an indoor pursuit. You're asked to create life in an artificial environment. So I'm looking forward to getting outside for a while – just going back to nature and observing. I think it's very important that we continually strive for some kind of artistry in this



A noted artist and sculptor, Dutra draws upon his lifelong study of wildlife and nature in designing and animating movie creatures.

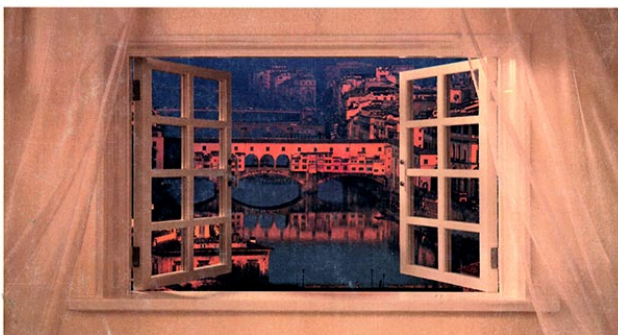
business. The skills that I'm reinforcing and strengthening now will give me an even broader base of contribution to film as an art form." Such keen powers of observation are the very skills which distinguish this animator's work. "The true animator is an actor, hired to give a performance – a characterization. My advice to animators is to study the movement of nature. Avoid third-hand information and go instead to the source. Observe how animals and people use their body language and gestures. The deeper your knowledge and experience, the truer, more layered your performance will be."

With several new film projects on the horizon, the artist's hiatus from special effects may be short-lived. Until then, however, he continues to paint and sculpt – adding to his already prolific and highly regarded body of work as a wildlife and landscape artist. Noted for its bold, innovative style, Dutra's work has earned him membership in the prestigious Society of Animal Artists; and many of his paintings and sculptures are currently on exhibit in galleries throughout the Southwest.

As if dual careers were not challenge enough, Dutra intends to remain open to new avenues of creative expression. "I look at life as having interest. So wherever my interest takes me, I'll go. I started off drawing and sculpting; and it took me into fine art which led me into the effects world. Now there's a whole new range of possibilities with the advent of computer technology in film." Guided by his fundamental approach to animation as an art, Dutra considers the new technology merely a means to an end. "It is not, nor will it ever be, a substitute for a creatively fertile mind; but it is a tool to help expand how we use our minds. CGI has already made the animator's job far more labor – and time-efficient. There's no gravity to fight or possible armature pops that can ruin an otherwise good take; we can save days, weeks, even months of work by key-framing procedures; we can create detailed paths of action, review shots in progress, enjoy immediate playback capabilities, virtually lift camera and lighting constraints, and finesse a shot to a remarkable degree. So I think it's going to have tremendous applications – not just in film, but all across the board."



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